

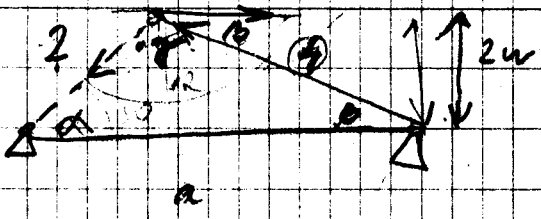
1.9.



$$\frac{\sin L}{\sin 60} = \frac{2}{6}$$

5.3

$$\frac{16 \cdot \sqrt{3}}{2}$$



$$R = 4m$$

$$m = 2\sqrt{5}$$

$$c^2 = a^2 + (2\sqrt{3})^2 - 2 \cdot 4 \cdot 2\sqrt{3} \cdot \cos 30$$

$$c^2 = 16 + 12 - 24$$

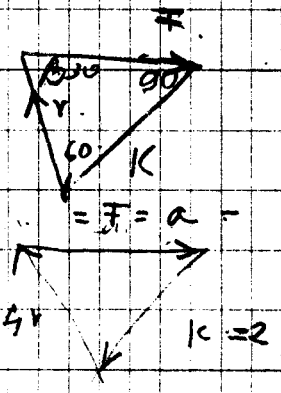
$$c = 2$$

$$\frac{\sin \alpha}{\sin 30} = \frac{2\sqrt{3}}{2}$$

$$\sin \alpha = 0,5 \cdot \sqrt{3}$$

$$\alpha = 60$$

$$\alpha = 90^\circ$$



$$\frac{F}{K} = \frac{a}{2}$$

$$K = \frac{F \cdot 2}{a} = \frac{4}{2\sqrt{3}}$$

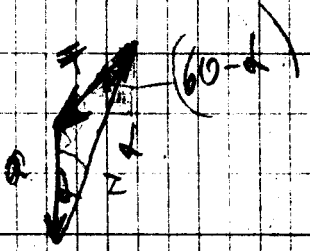
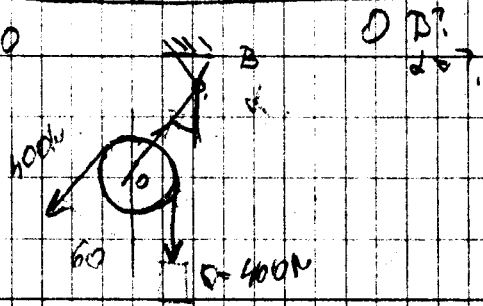
$$\frac{F}{r} = \frac{a}{4}$$

$$R = \frac{F \cdot 4}{a} = \frac{2}{\sqrt{3}}$$

$$\boxed{\frac{2}{\sqrt{3}}}$$

$$\boxed{\frac{4}{\sqrt{3}}}$$

1.10



$$\frac{\sin(60-\alpha)}{\sin \alpha} = \frac{Q}{F}$$

$$\sin(60-\alpha) = 1$$

$$\sin(60-\alpha) = \sin \alpha$$

$$\alpha = 30^\circ$$

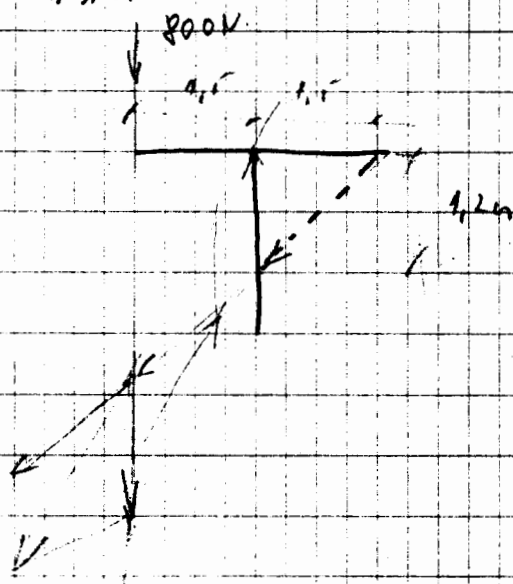
$$\frac{Q}{2} = \frac{\sin 30}{\sin 120}$$

$$Q \cdot \sin 120 = 2 \cdot \sin 30$$

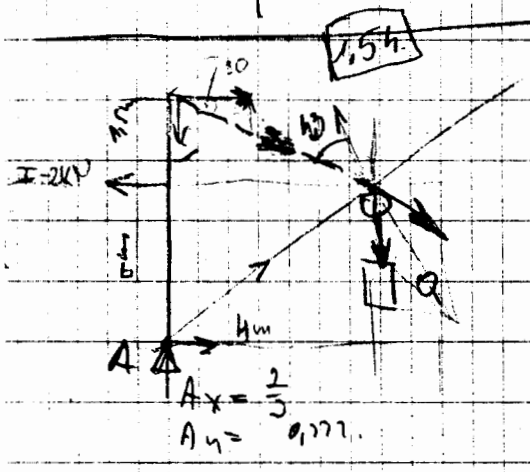
$$c = 692 + 8$$

1. 11.

Wochen



1. 12 1.



$$\frac{1.5}{1.5} = \frac{x}{4} = \frac{1.6}{1.7}$$

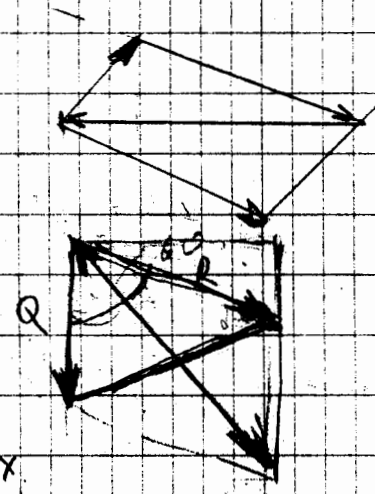
$$\frac{4}{3} = \frac{1.6}{1.7} = \frac{8}{30}$$

$$\sum M_A = 0 = -3 \cdot 2 + 4.5 K_x$$

$$K_x = 1.5 \text{ kN}$$

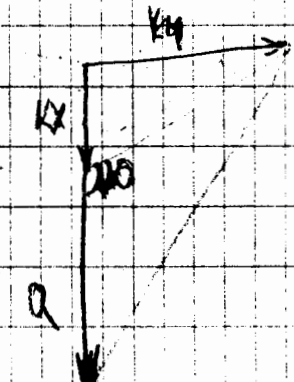
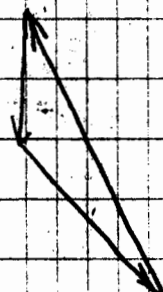
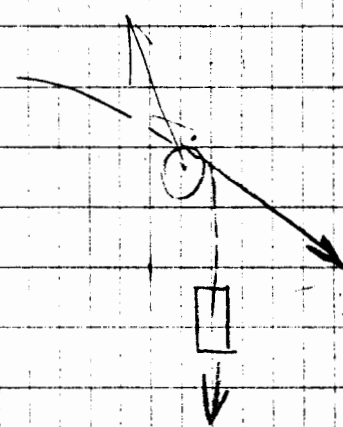
$$K_y = 0.777$$

$$K_R = 1.54 \text{ kN}$$



$$R_y = Q + K_y$$

$$R_x = K_x$$



$$K_x^2 + (K_y + a)^2 = Q^2 + K_R^2 - 2QK_R \cos 120$$

$$K_x^2 + K_y^2 + 2K_y a + a^2 = Q^2 + K_R^2 - 2QK_R \cos 120$$

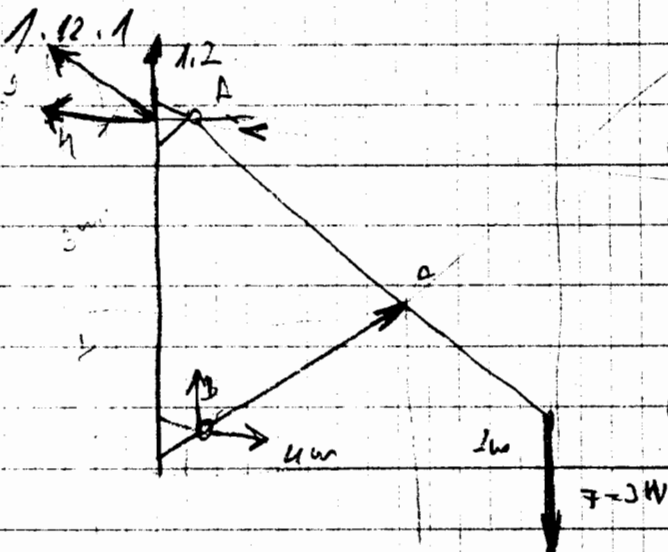
$$K_x^2 + K_y^2 - K_R^2 = -2K_R Q (\cos 120 + 1)$$

$$(\cos 120 + 1) (-) 2K_R = \frac{-544}{-1.54}$$

$$Q = 0.3536 \text{ kN}$$

$$\alpha = 43^\circ$$

$$R_x = 0.5758 \quad R_y = 1.57 \quad R = 1.644 \text{ kN}$$



$$\sum M_A = 0 = 6 \cdot 3 - 5 \quad B_x = 0$$

$$B_x = 3.6$$

$$\sum X_i = 0$$

$$A_x = B_x = 3.6$$

$$\sum Y_i = 0$$

$$\frac{3}{4} = \frac{A_y}{A_x}$$

$$A_y = \frac{3 \cdot 3.6}{4} = 2.7$$

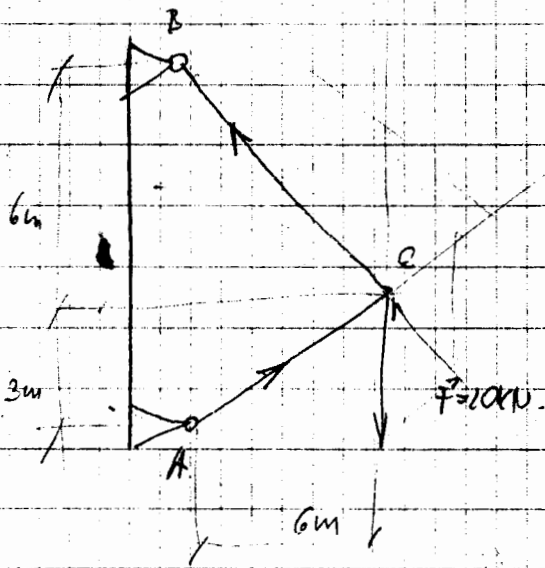
$$B_y = 1.8$$

$$A_x = 1.2$$

$$R = 3.79$$

$$B_R = 4.02$$

1.12.3



$$\sum M_A = 0 = +6 \cdot 20 - 9 \cdot B_x$$

$$B_x = 13,3 \text{ kN}$$

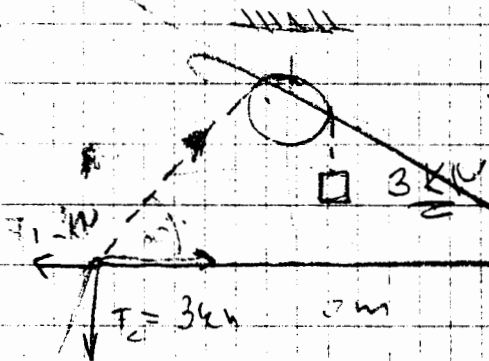
$$\sum X_i = 0 =$$

$$A_x = B_x = 13,3 \text{ kN}$$

$$A_y = 6,6 \text{ kN}$$

$$B_y = 13,3 \text{ kN}$$

1.12.4

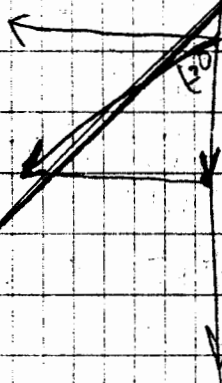
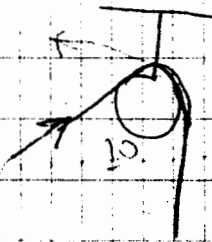


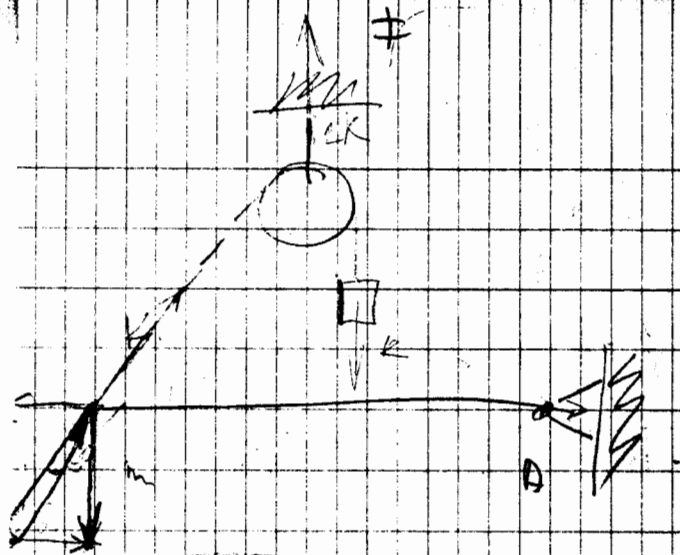
$$\sum M_A = 0 =$$

$$K_y = 3 \text{ kN}$$

$$K_x = 11,73 \text{ kN}$$

$$K = 3,4 \text{ kN}$$





$R = 3.6$

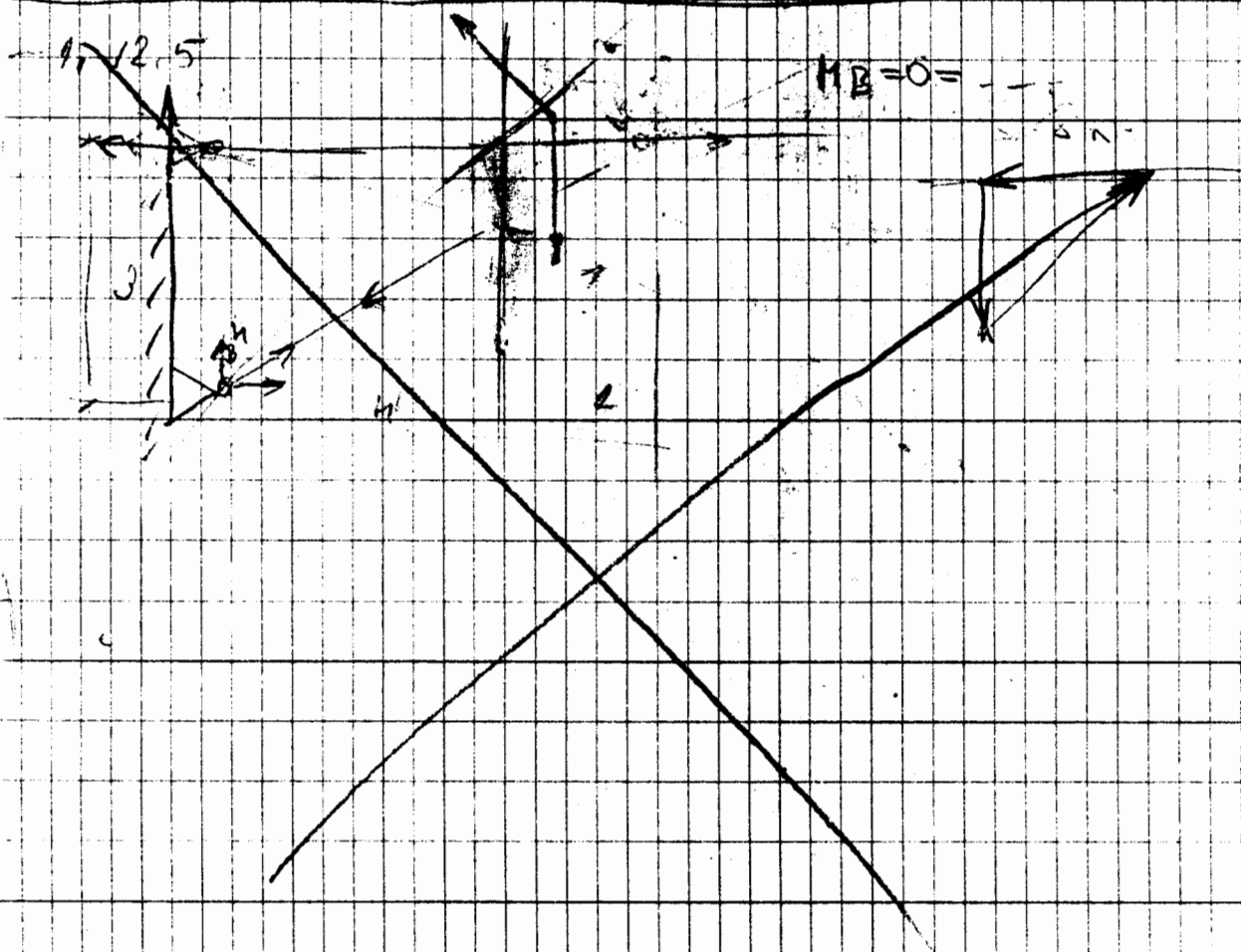
$A =$

$K = 3464$

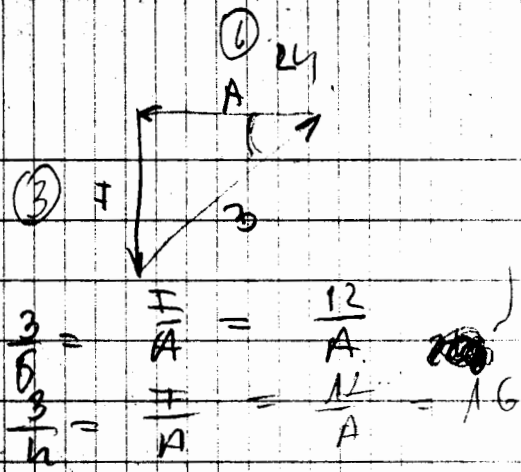
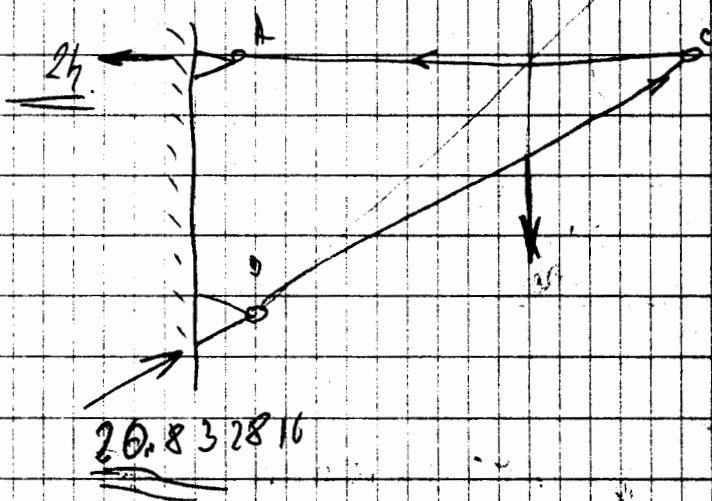
$K_V = 1.752$

$A_X = 0.1768$

$F = 6.978$



1.12.5



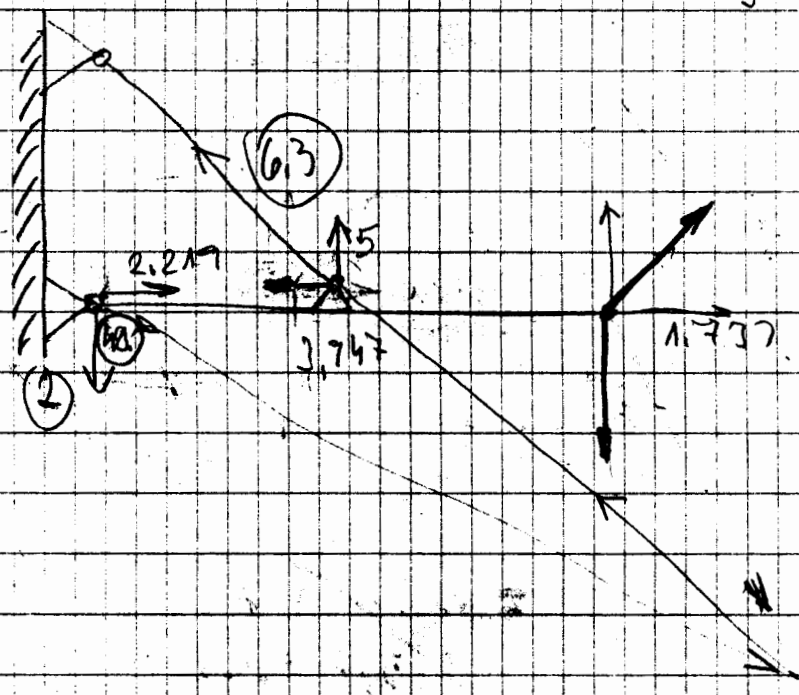
$$\frac{3}{5} H = \frac{12}{A}$$

$$\frac{3}{5} \frac{3}{4} H = \frac{12}{A}$$

$$\frac{9}{20} H = \frac{12}{A}$$

$$H = \frac{12 \cdot 20}{9 \cdot A} = \frac{26.67}{A}$$

1.12.6



$$\frac{2.2}{3} = \frac{5}{X}$$

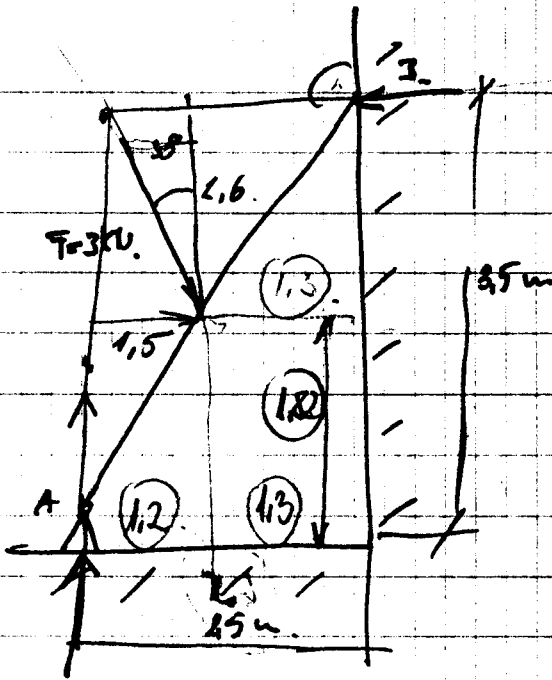
$M_A = 0$

1.12.17

$$\frac{2,5}{3,5}$$

1,2

$$\frac{1,3}{\lambda} = 1,62$$



40m/s

$$\sum \mathcal{M}_A = 0 = 1,5 \cdot 1,82 + 2,6 \cdot 3,5 - 3,5 \cdot DX$$

$$DX = 1,6714786$$

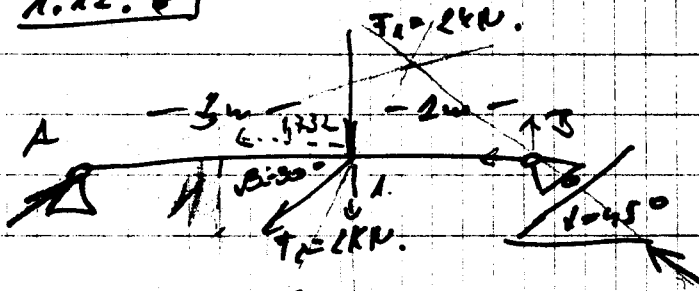
$$\sum X_i = 0, \quad AX \Rightarrow 0,17$$

$$\sum Y_i = \uparrow AY = 2,6$$

$$A = 2,60 \text{ BDA} + NS = 0 + 2,6$$

$$01 \quad 21 = 8$$

1.12.18



8m/s

$$\sum \mathcal{M}_A = 0 = 3 \cdot 1 + 2 \cdot 2 - 5 \cdot By$$

$$By = 1,8 \text{ kN}$$

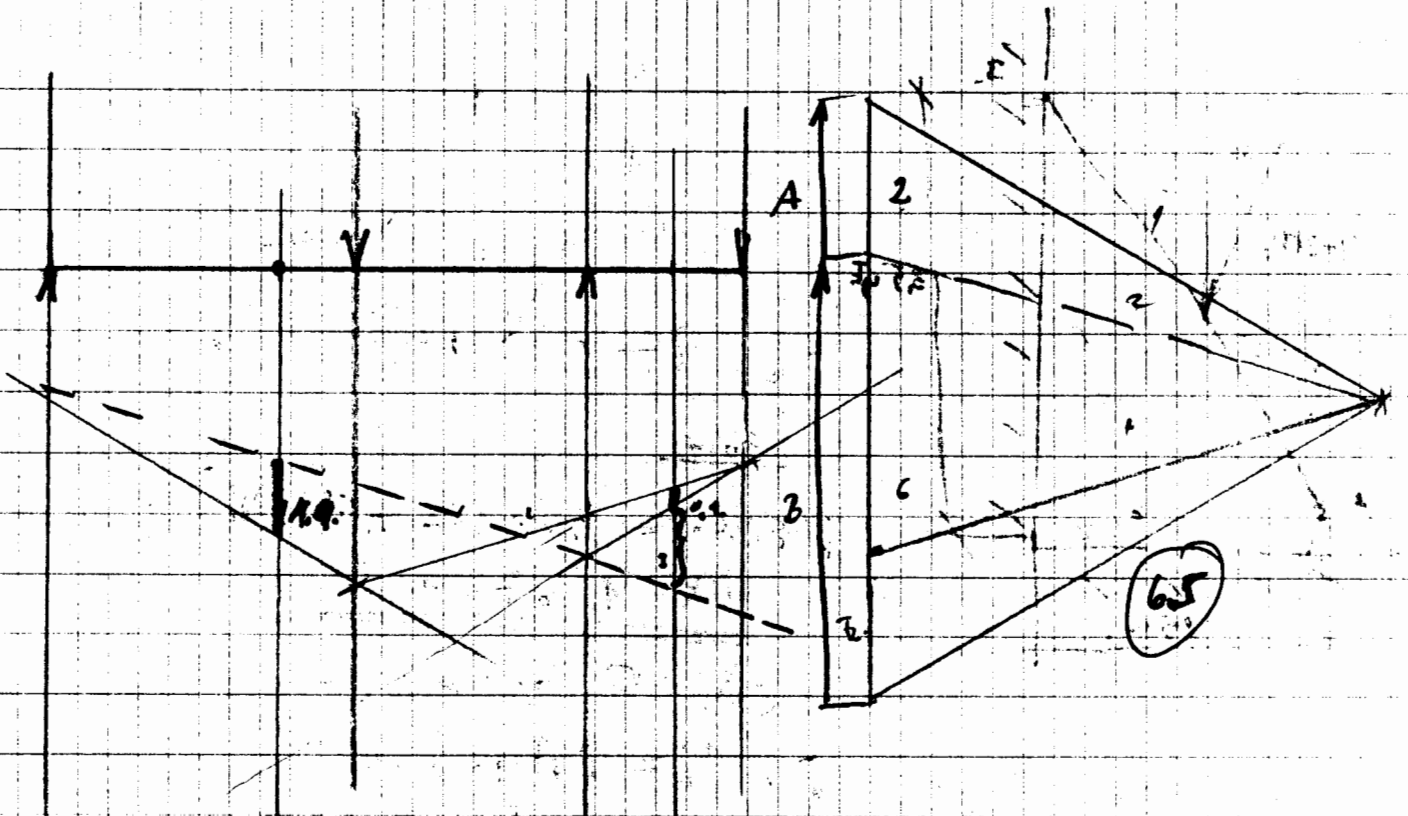
$$Bx = 1,8 \text{ kN}$$

$$\sum X_i \Rightarrow \rightarrow AX = 3,5371 \text{ kN}$$

$$\sum Y_i \Rightarrow \uparrow AY = 112,4 \text{ N}$$

San'ida



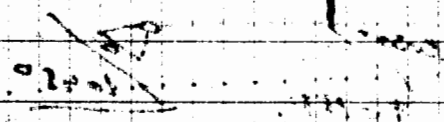


$$3.2 + 6 = 24 + 12$$

$$8 \rightarrow 18 \quad 10$$

$$G \quad 1 \quad 24 \quad 6 \quad 2.$$

(65)

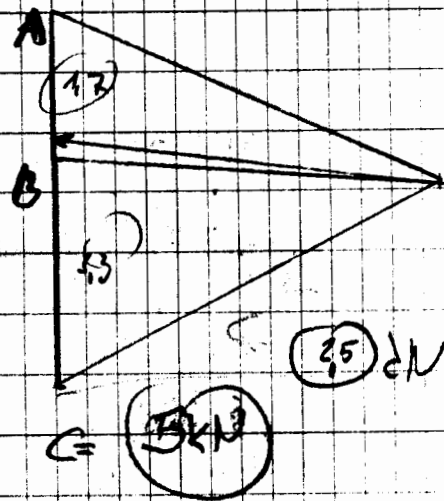
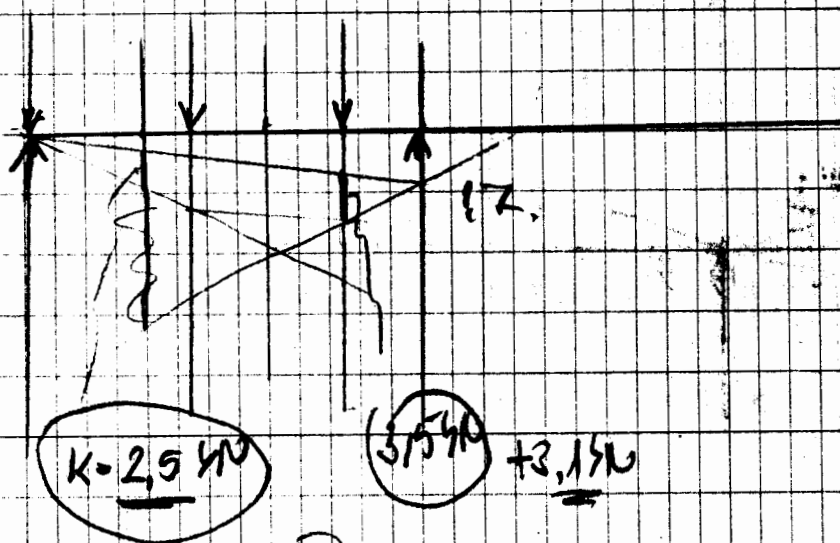




2.4.1

2 kN

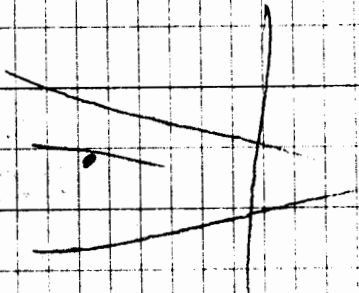
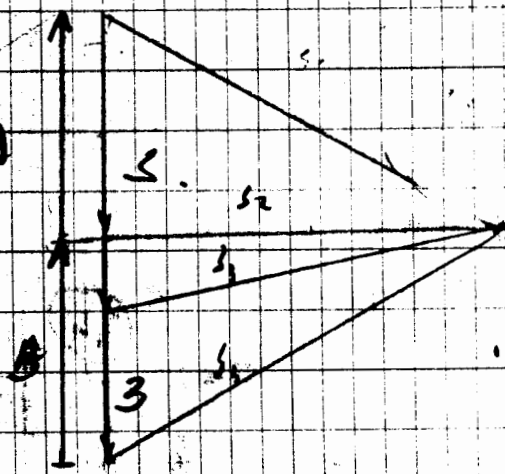
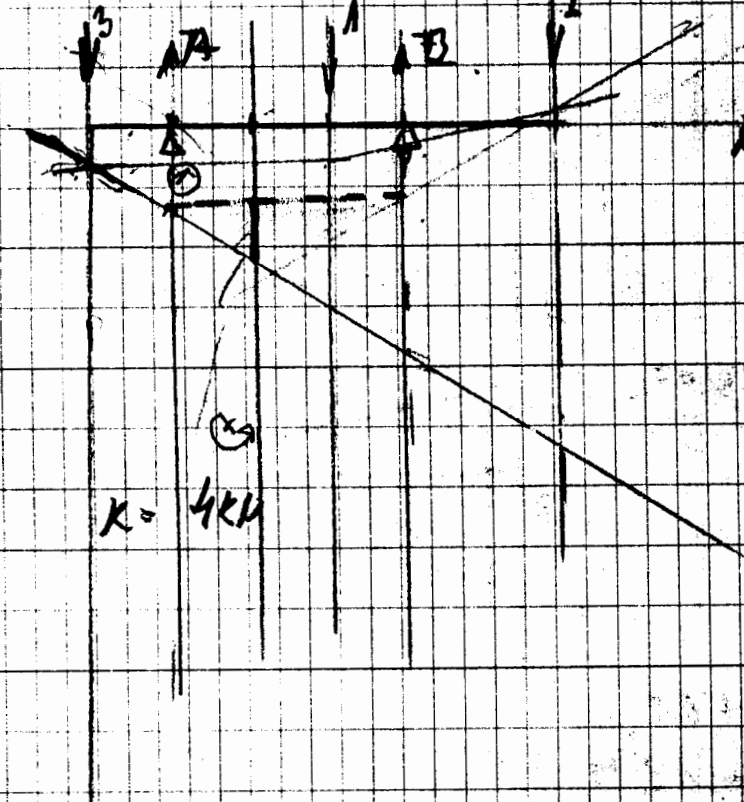
3 kN



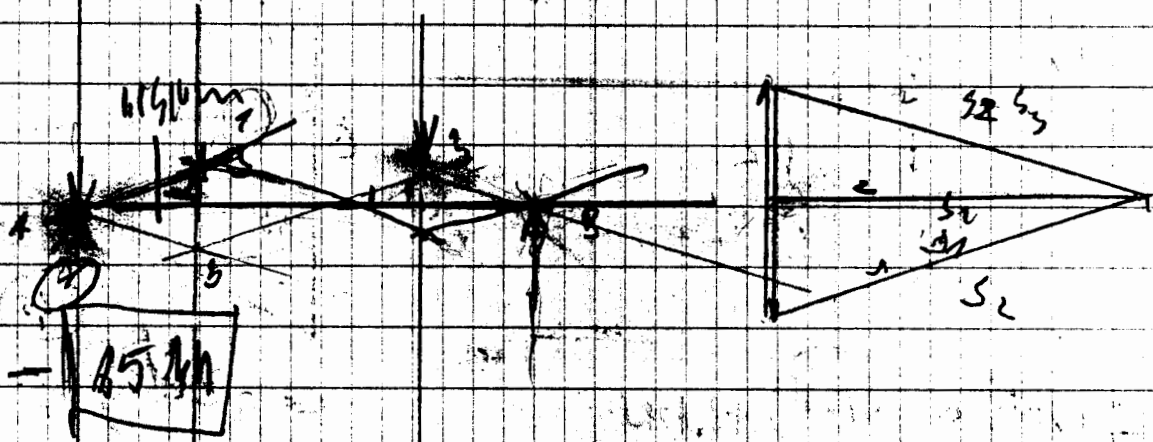
2.4.2

1

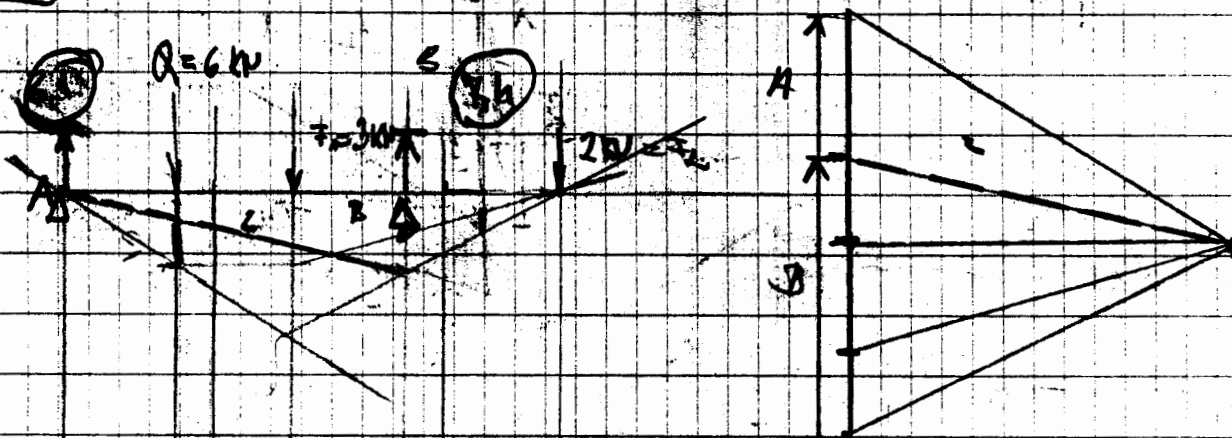
1



2.4.3



2.4.4



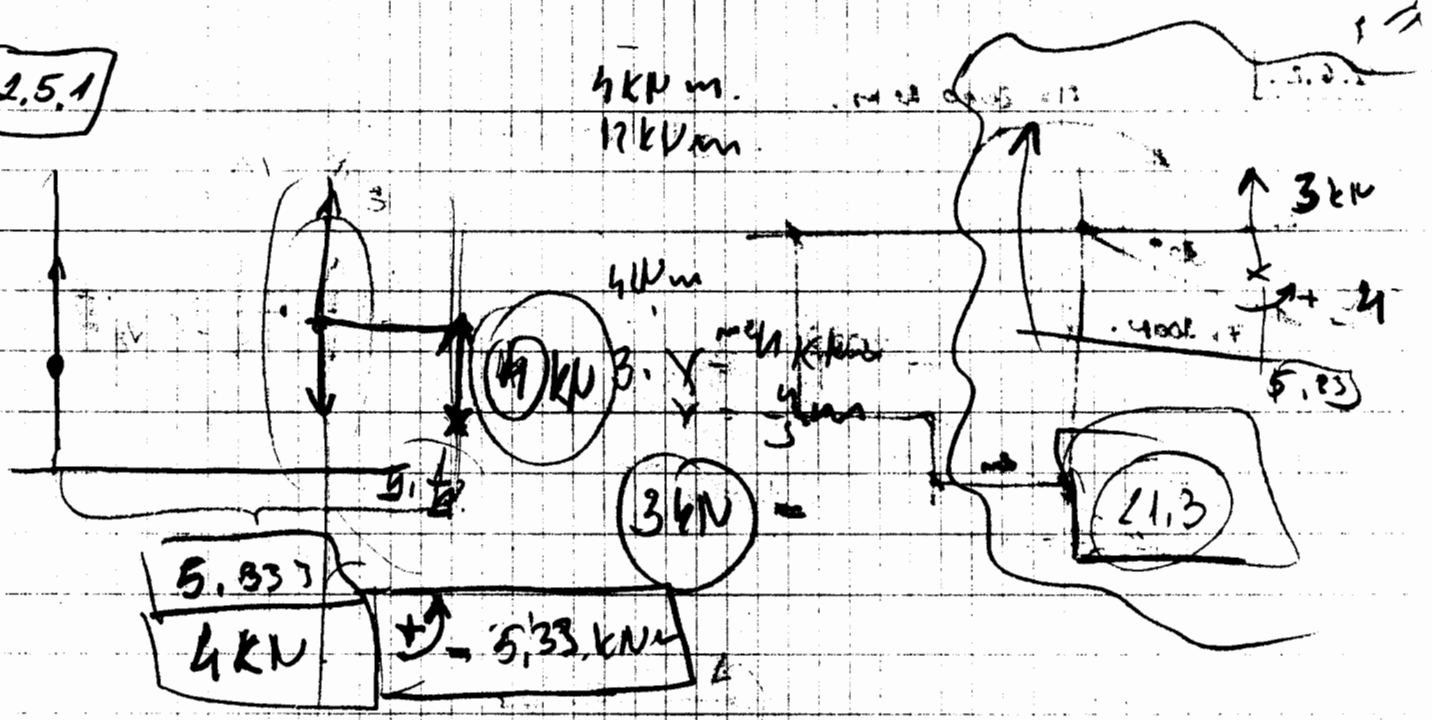
$$15 \cdot 6 + 3 \cdot 2 - 4,5 \cdot 4 + 6 \cdot 2$$

$$9 + 9 - 18 + 12 = 6$$

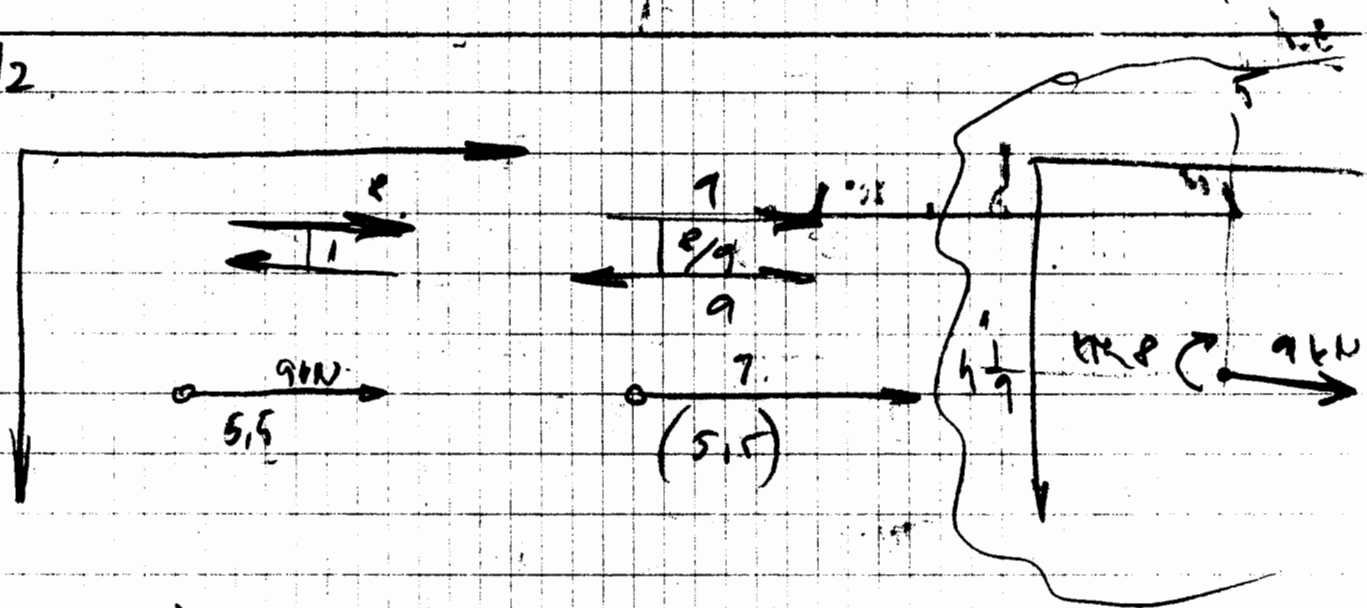
$$15 \cdot 6 + 3 \cdot 3 - 4,5 \cdot 3 + 2 \cdot 6 = 6,8$$

6,8	4,1
B	A

2.5.1

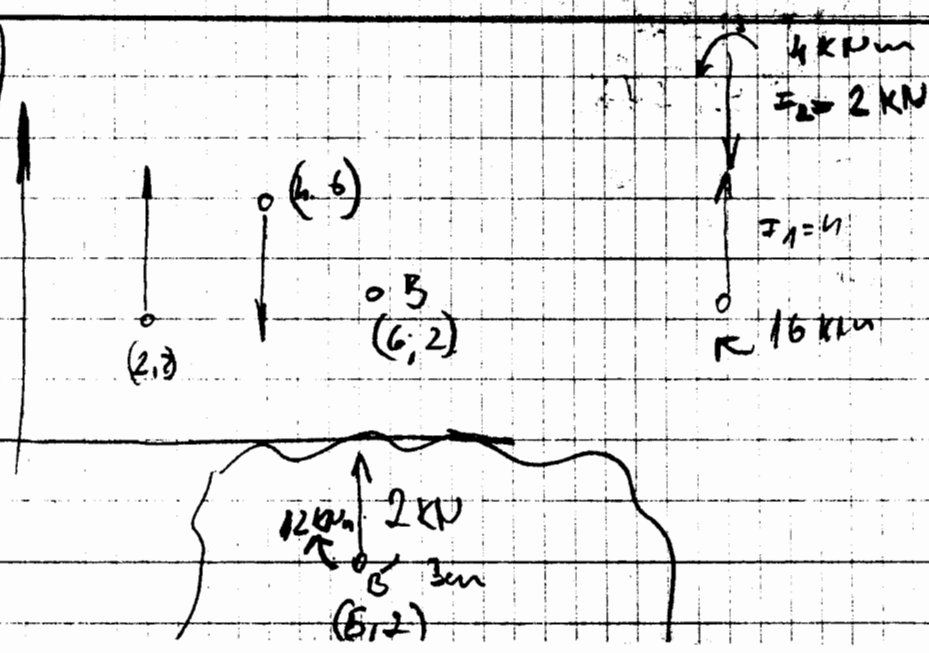


2.5/2

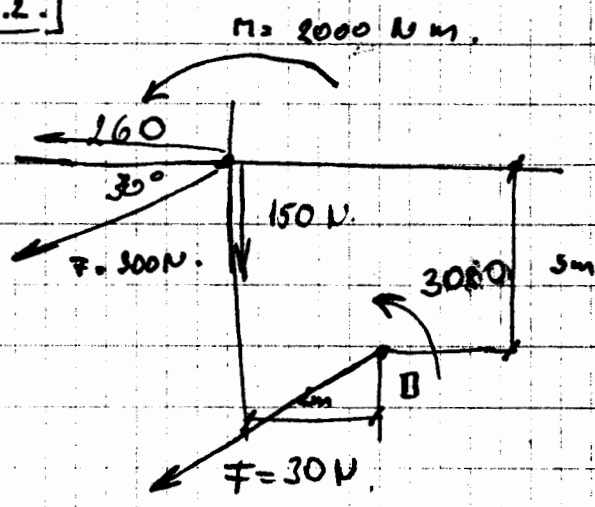


$(4 \frac{1}{9} 9)$  89kNm

2.6

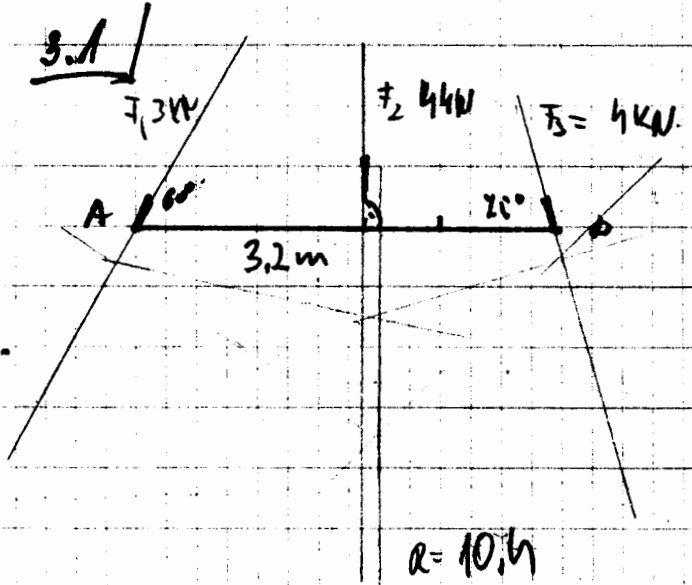


2.6.2.]



$$\sum +M_D = 300 + 780 = 1080$$

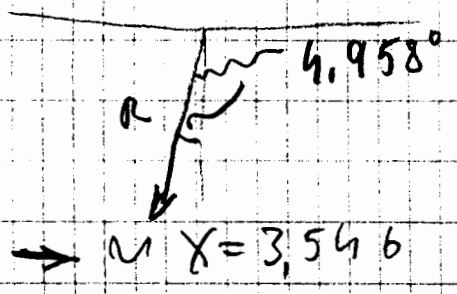
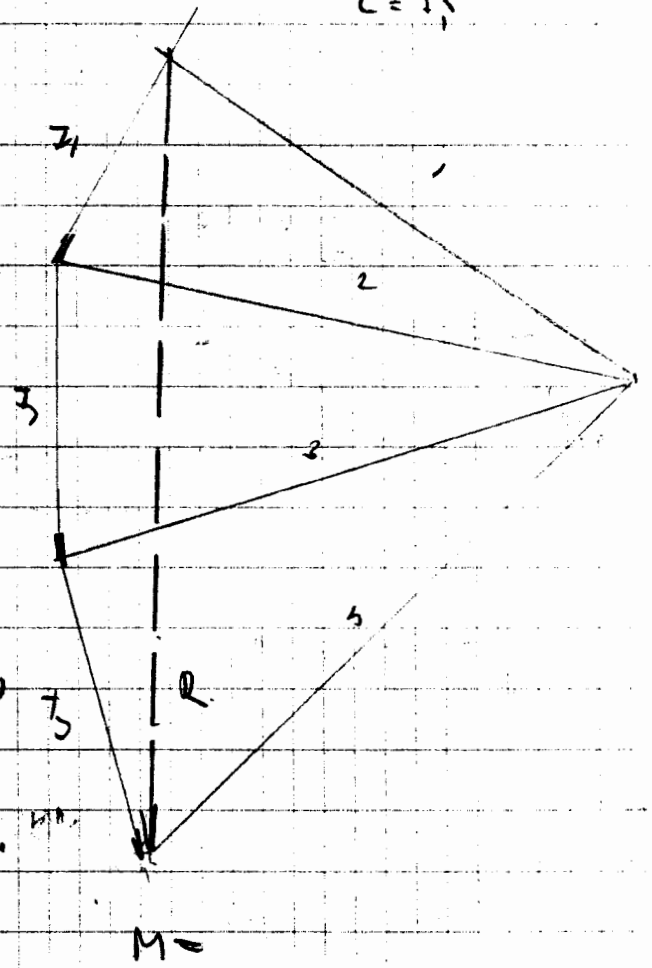
3.1



C = 75

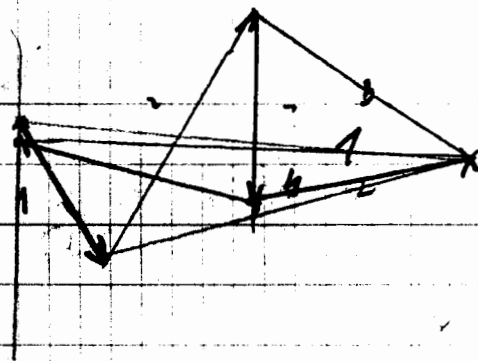
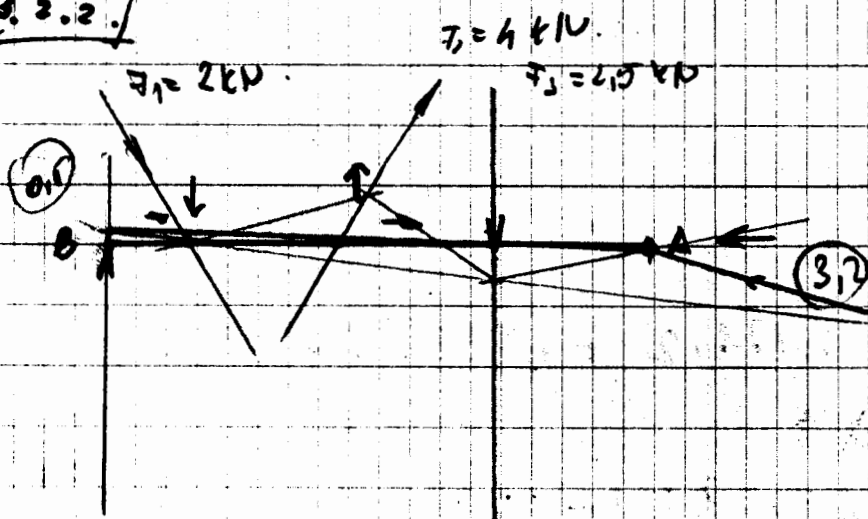
$$\begin{aligned} F_{1x} &= 1.5 \\ F_{1y} &= 2.598 \\ F_{3x} &= 1.035 \\ F_{3y} &= 3.26 \end{aligned}$$

$$\begin{aligned} R_x &= 0.465 \text{ kN} \\ R_y &= 9.36 \\ R &= 9.37 \text{ kN} \\ \alpha &= \end{aligned}$$



$$4 \cdot 3 \rightarrow 5.5 \cdot 3.26 = x \cdot 9.36$$

3.2.2



$$\sum M_0 = 0 = -1 \cdot 1.752 + 3 \cdot 3.464 +$$

$$-5 \cdot 2.5 + 7 \cdot A_y$$

$$A_y = 5.4852$$

$$\rightarrow F_x = 1$$

$$\downarrow F_y = 1.752$$

$$F_x = 2$$

$$F_y = 3.464$$

$$\sum \eta_i = 0 = +B - 1.752 + 3.464 - 2.5 + 0.564$$

$$B = 0.2175$$

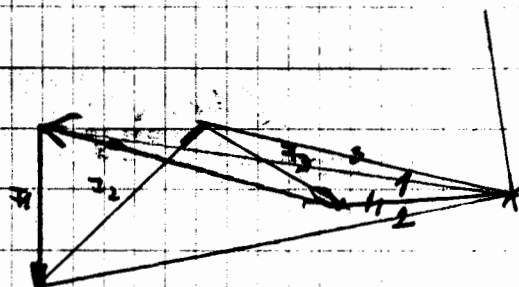
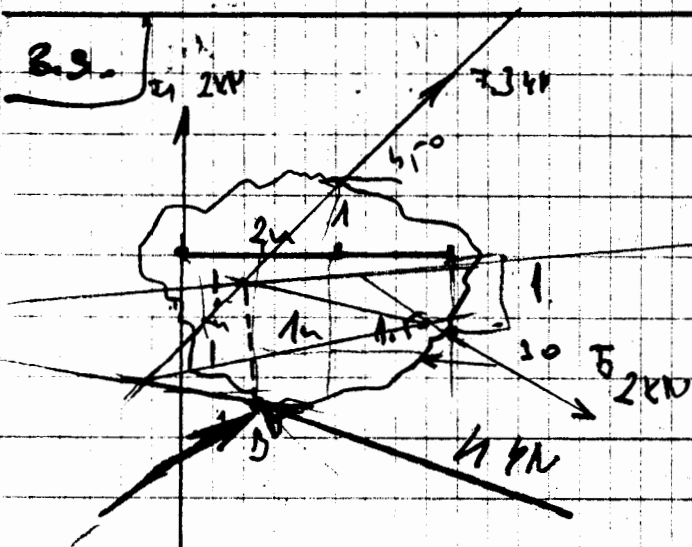
$$\sum \nu_i = 0 = 1 + 2 - A_x$$

$$A_x = 3$$

$$A = 3.05$$

20

3.3



5. ...

$$F_2 \cdot x = 2.121$$

$$F_1 \cdot y = 1$$

$$F_3 \cdot x = 1$$

$$F_5 \cdot y = 1.737$$

$$\sum M_A = 0 = -2.121 \cdot 1 + 2.171 \cdot 2 + 1.732 \cdot 1 - 1 \cdot 3.5 + B_x \cdot 2 + B_y \cdot 1$$

$$\sum M_B = 0 = -3.5 \cdot 2 - 1.5 \cdot 2.171 - 2 \cdot 2.171 - B_x \cdot 1 - D_y \cdot 2.5$$

$$0 = 0.353 - B_x \cdot 2 + B_y \cdot 1$$

$$0 = 14.477 = B_x \cdot 1 + B_y \cdot 2.5$$

$$-28.954 = B_x \cdot 2 + B_y \cdot 5$$

$$0 = 28.2 + 6B_y$$

$$B_y = -4.86$$

$$0 = 0.353 - B_x \cdot 2 + 4.86$$

$$B_x = 2.609$$

$$R = 5.15160$$

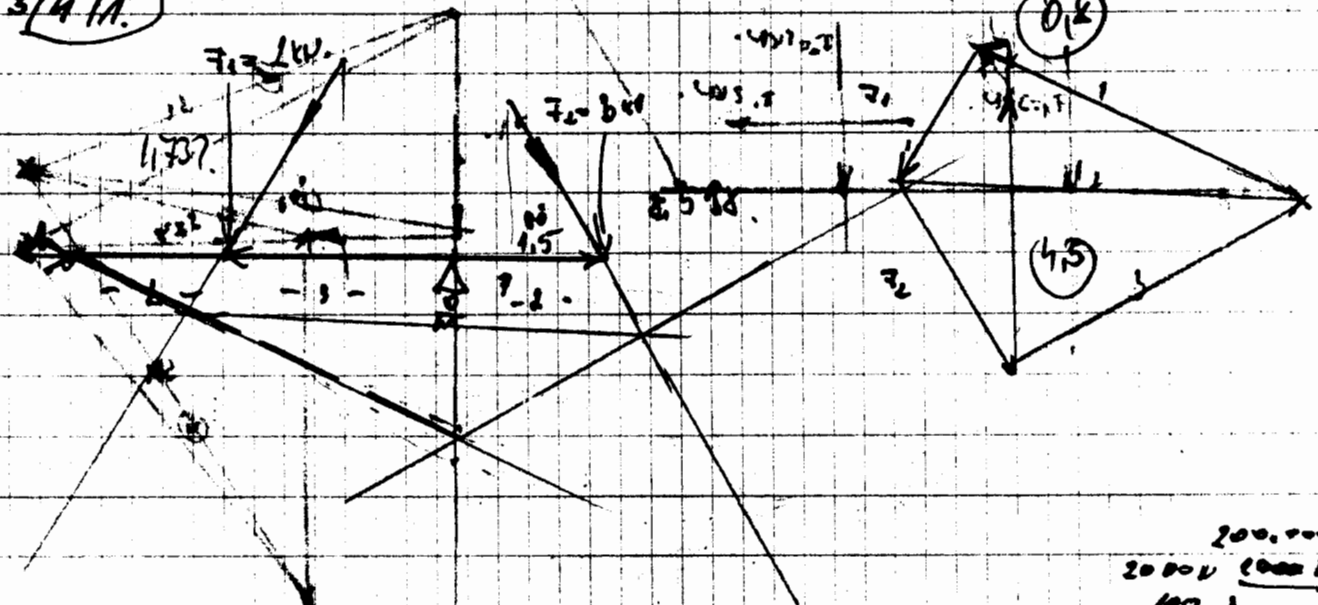
$$x = 3.471$$

$$y = 5.453 \text{ es}$$

$$R = 6.623$$



3.4.1A.



$$\sum M_A = 0 = 2 \cdot 1.732 - 5 \cdot B + 7 \cdot 2.598$$

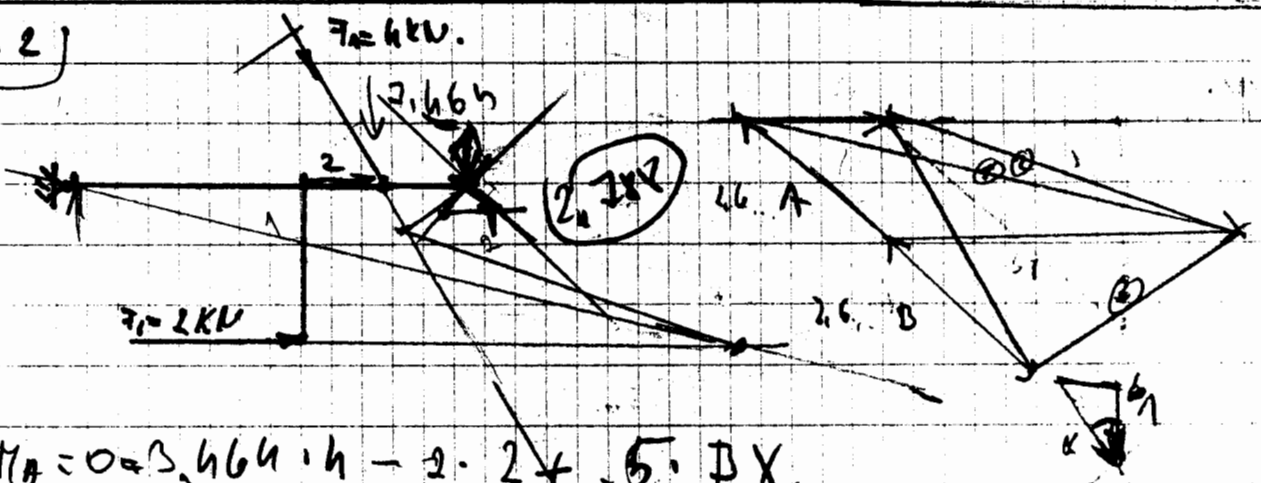
$$B = \underline{4.33}$$

$$\sum Y_i = -1.732 + 4.33 - 2.598$$

$$\sum X_i = A_x = 0.5$$

200.000 N.  
 20000 (2000) 20  
 100  
 20000 P.  
 20 kN.  
 20 kN.  
 20000 P.  
 20000 P.  
 20000 P.  
 1MP = 10 N.  
 20000 MP = 2000 kg.  
 20000 P.

3.4.2)



$$\sum M_A = 0 = 2.464 \cdot 4 - 2 \cdot 2 + 5 \cdot B_x$$

$$B_x = \underline{-1.9772}$$

$$B_x = \underline{1.977}$$

$$B_x = \underline{2.288}$$

$$A_x = \underline{2.288}$$

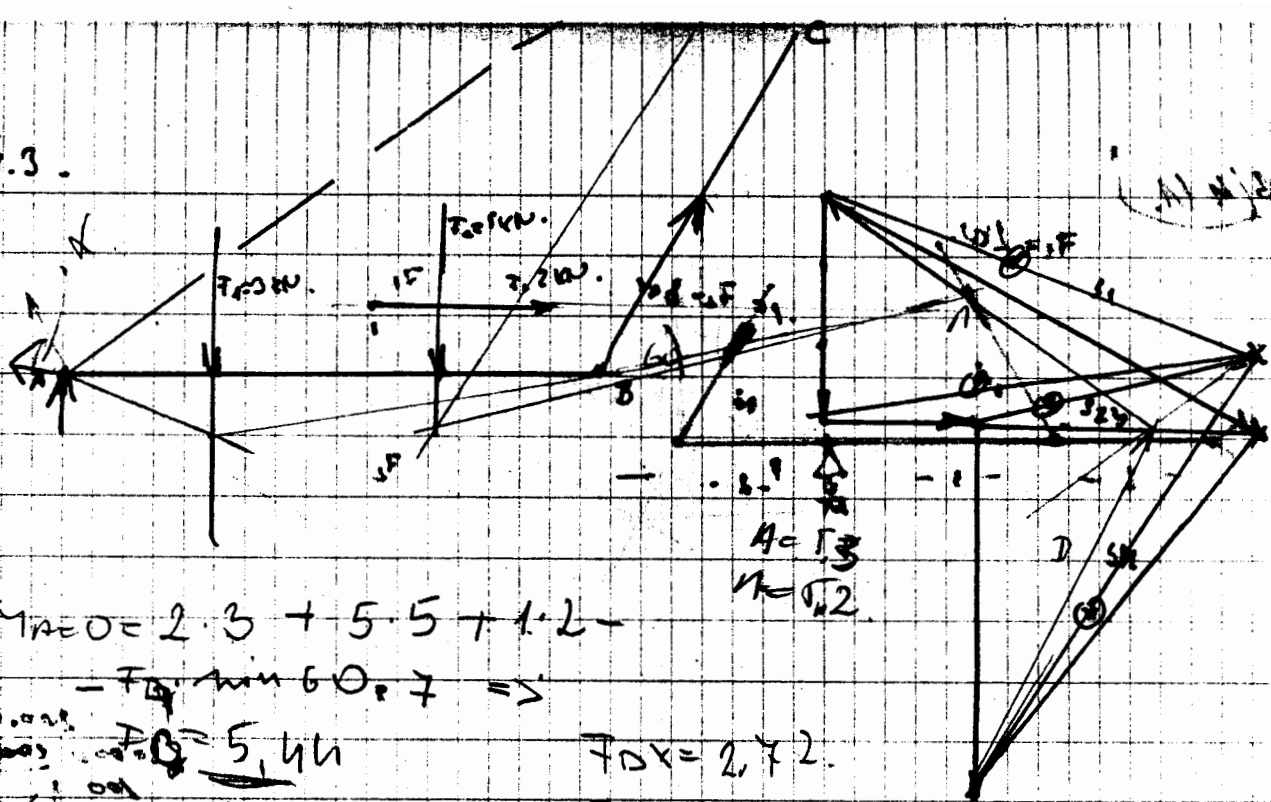
$$\sum X_i = 2 - 1.977 \Rightarrow A_x = 2.288 \leftarrow$$

$$\sum Y_i = 2.464 + 1.977$$

$$A_y = 1.691 \uparrow$$



3.6.3.



$$\sum M_{AEO} = 2 \cdot 3 + 5 \cdot 5 + 1 \cdot 2 =$$

$$= F_{Dy} \sin 60 \cdot 7 \Rightarrow$$

$$F_{Dy} = 5.44$$

$$\sum F_x = 0 \Rightarrow A_x = 4.72$$

$$\sum F_y = 0 \Rightarrow A_y = 3.288$$

$$A = 5.75$$

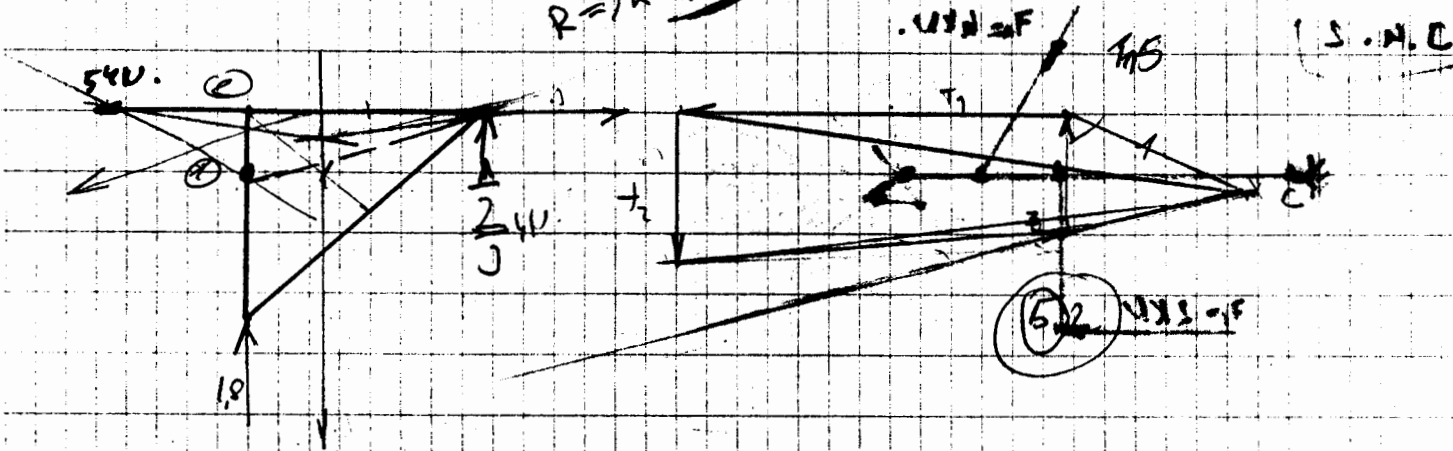
$$F_{Dx} = 2.72$$

$$F_{Dh} = 4.711$$

$$R = 34.19$$

Handwritten notes and scribbles.

$$R = 34.19$$



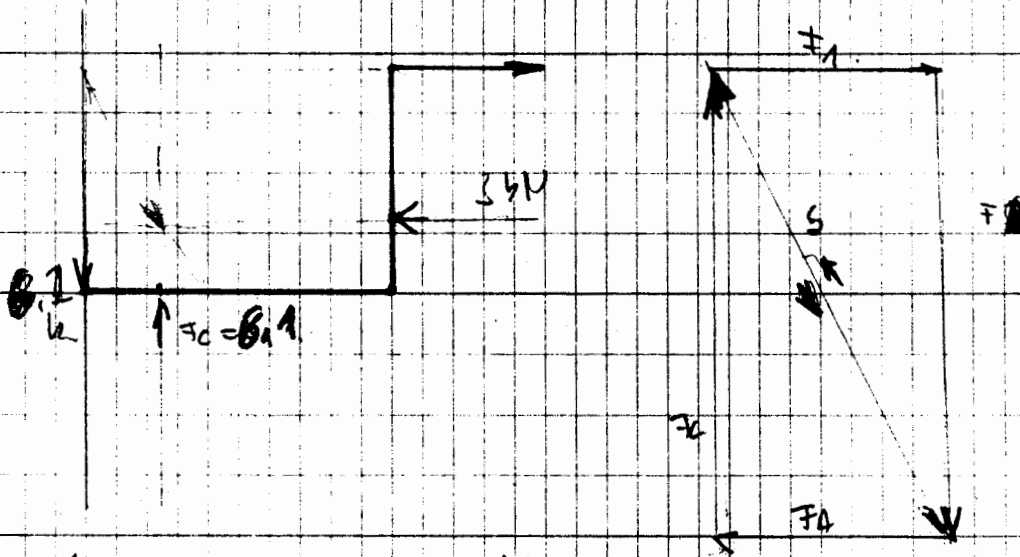
$$\sum M_A = 0 = A_y \cdot 3 - 2 \cdot 2$$

$$\Rightarrow A_y = \frac{4}{3}$$

$$\sum F_x = 0 \Rightarrow A_x = 5 \text{ kN}$$

$$\sum F_y = 0 \Rightarrow A_y = \frac{2}{3} \text{ kN}$$

3.4.5



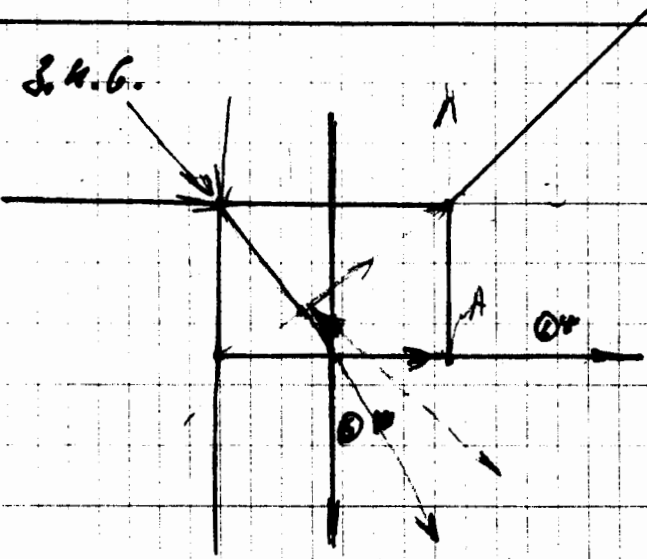
$$\sum X_i = 0 \Rightarrow A_x = 37 \text{ N}$$

$$\sum M_B = -1 \cdot F_{cy} + 3 \cdot 3 - 1 \cdot 3$$

$$\downarrow F_{cy} = 6 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow A_y = 6 \text{ kN}$$

3.4.6.



$$\sum M_B = 1.5 \cdot 5 - 2 \cdot 2 - 3 \cdot c_y = 0$$

$$c_y = 1.166$$

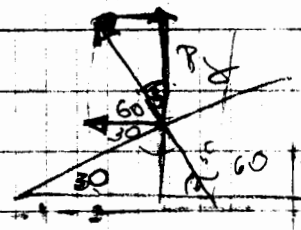
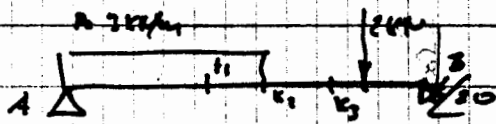
$$c_x = 1.166$$

$$C = 1.65$$

$$\sum X_i = 0 \Rightarrow A_x = 3.166$$

$$\sum Y_i = 0 \Rightarrow B_y = 3.834$$

4.1.1.



$Q = 9 \text{ kN}$

$\sum \mathcal{M}_A = 0 = 1.5 \cdot 7 + 5 \cdot 2 - 9 \cdot 3 \cdot \cos 30$

$B = 4.52$

$B_x = 2.26$

$B_y = 3.91 \text{ kN}$

$\sum \mathcal{V}_i = A_x = 2.26 \rightarrow$

$\sum \mathcal{H}_i = A_y = 3.91 \uparrow$

$K_1$

$N = -2.26$

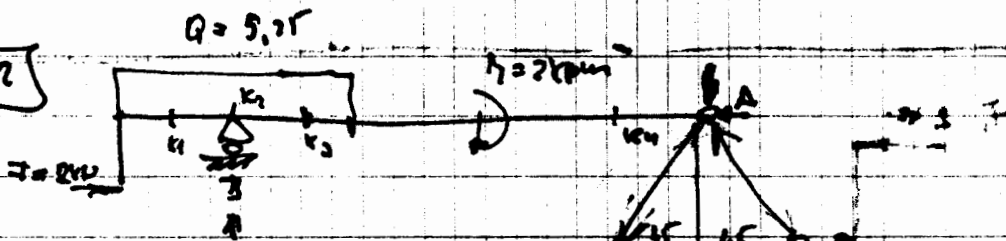
$T = 11.69$

$M = 4.09 \cdot 1.8 - 0.9 \cdot 1.8 \cdot 3$

$M = 4.907$

$K_2$

4.1.2



$\sum \mathcal{M}_A = 0 = 2 + 5.25 \cdot B_y -$

$- 5.25 \cdot 5.25 - 1 \cdot 2$

$B_y = 15.48$

$\sum \mathcal{V}_i \Rightarrow A_x = 2 \text{ k}$

$\sum \mathcal{H}_i \Rightarrow A_y = 0.43$

$K_1$

$N = -2 \text{ k}$

$T = 11.6 \text{ kN}$

$M = 2.75 \text{ kN}$

$K_2$

$N = 2 \text{ kV}$

$T = 0.43$

$M = 0.43 \text{ kN}$

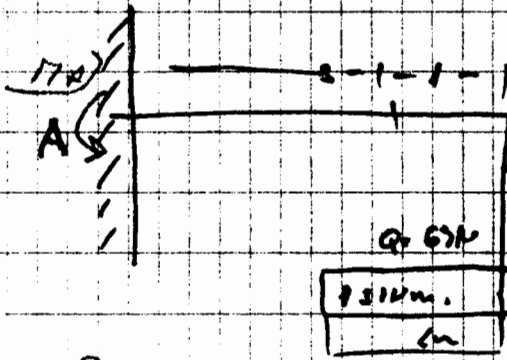
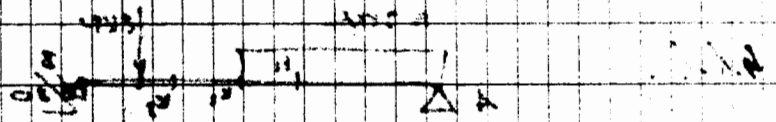
$K_2$

$N = -2 \text{ kV}$

$T = 3 \text{ kV}$

$\mathcal{M}_2 = 2 - 3.1 = 0.55 \text{ kN}$

4.1.3



$$\sum M_A = 0 = +2 \cdot 3 + 6 \cdot 3 \cdot \frac{3}{2} - R_A \cdot 3 = 0$$

$$20 \text{ kNm}$$

$$\sum X_i = 0 \Rightarrow R_A X = 2 \text{ kN} \rightarrow$$

$$\sum Y_i = 0 \Rightarrow R_A Y = 6 \text{ kN}$$

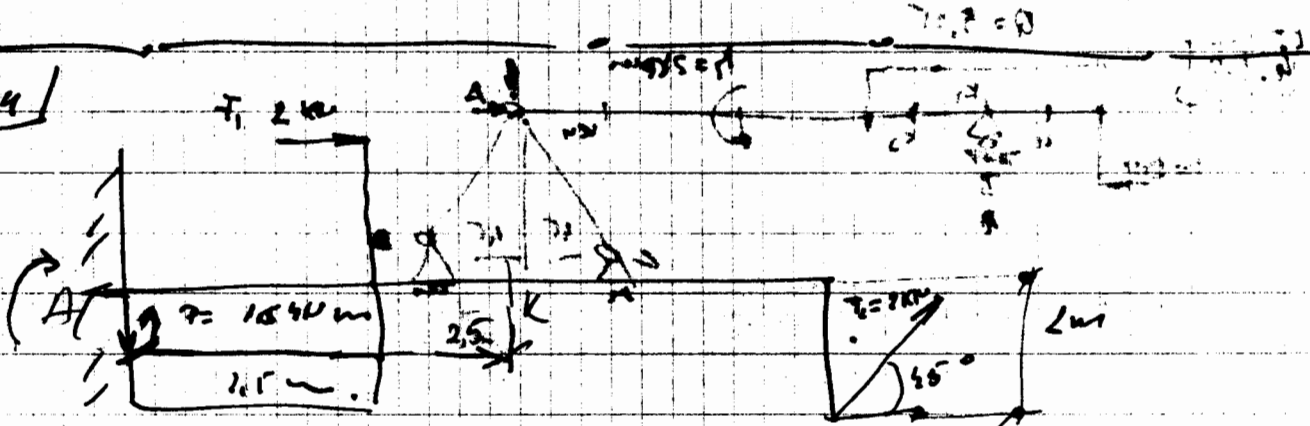
$[K_1] =$

$$N = -2 \text{ kN}$$

$$T = \uparrow 6 \text{ kN}$$

$$M = \ominus 20 \text{ kNm}$$

4.1.4



$Q = 3.75$

$\rightarrow F_{1x} = 1.414 \text{ kN}$   
 $\uparrow F_{1y} = 1.41 \text{ kN}$

$$\sum M_A = 0 \quad 0 = +M_A + 3 - 3.75 \cdot 1.25 - 5.5 \cdot 1.41 - 2 \cdot 1.41$$

$$\Rightarrow M_A = \underline{12.2625}$$

$$\sum X_i = \leftarrow R_A X = 3.41 \text{ kN}$$

$$\sum Y_i = \downarrow R_A Y = 5.16$$

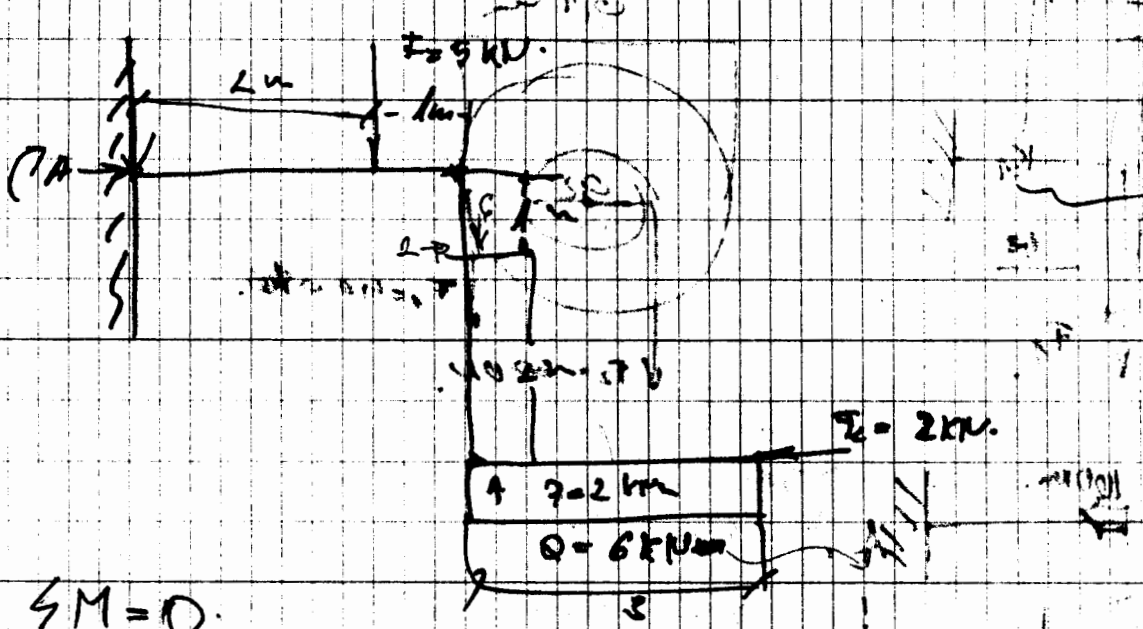
$[K_1] =$

$$N = \leftarrow + 1.41$$

$$T = \downarrow 1.41$$

$$\sum M = 12.2625 - 2.5 \cdot 5.16 + 2 \cdot 1.5 + 2.25 \cdot 3.75$$

4.1.5.



$\sum M = 0$

$\sum M = 0 = +M_A + 2 \cdot 5 + 3 \cdot 2 - 5 \cdot 4,5$

$M_A = 6,5 \text{ KNm}$

$\sum X_i = 0 \Rightarrow A_X = 2 \text{ KN} \rightarrow$

$\sum Y_i = 0 \Rightarrow A_Y = 1 \text{ KN} \downarrow$

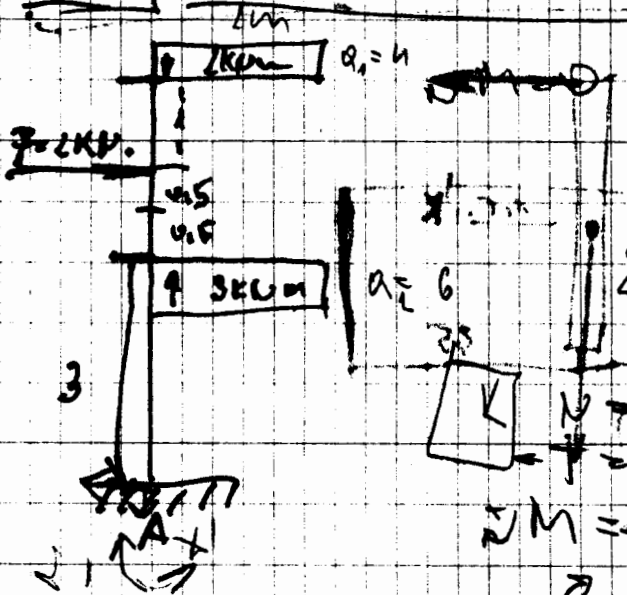
**K<sub>1</sub>**

$N = -6 \text{ KN}$

$T = \uparrow 2 \text{ KN}$

$\sum M = 6,5 - 5 - 3 = 1,5 \text{ KNm}!$

4.1.6.



$0 = M_A - 1 \cdot 6 + 1,4 \cdot 7 + 2 \cdot 4$

$M_A = 6 \text{ KNm}$

$\sum X_i = 0 \Rightarrow A_X = \leftarrow 2 \text{ KN}$

$\sum Y_i = 0 \Rightarrow A_Y = \downarrow 2 \text{ KN}$

$N = (-4 \text{ KN})$

$T = \uparrow 2 \text{ KN}$

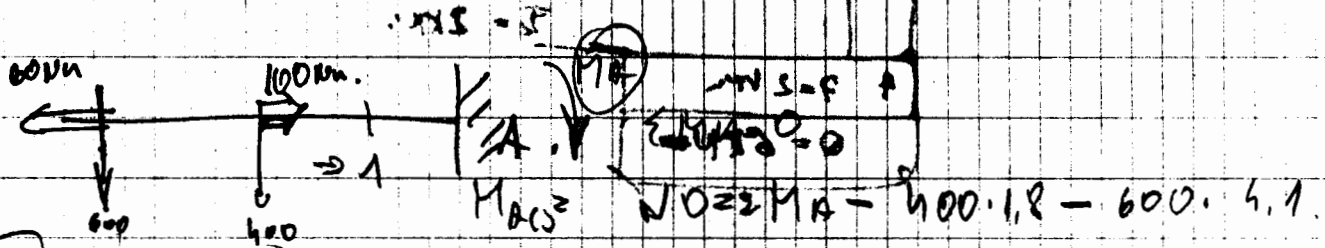
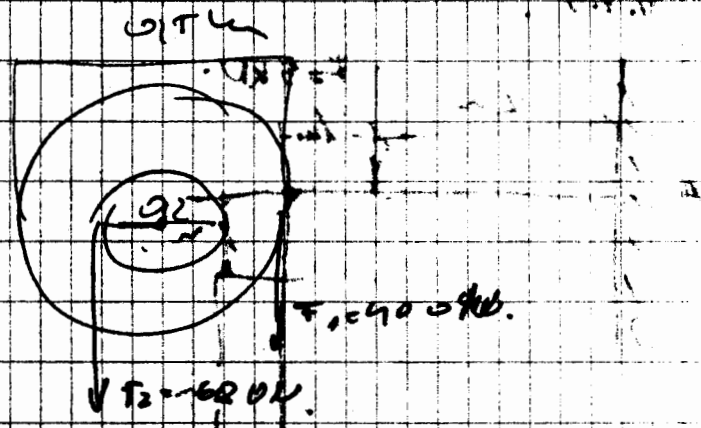
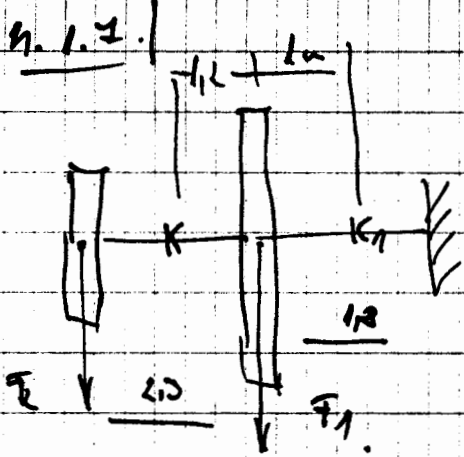
$\sum M = -6 + 3,5 \cdot 2 = 1 \text{ KNm}$

$\sum M = 1 \text{ KNm}$

$5 \text{ KN}$

$400 \text{ ?}$

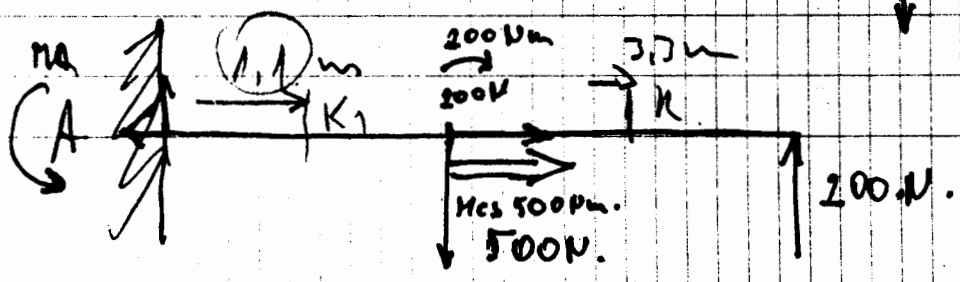
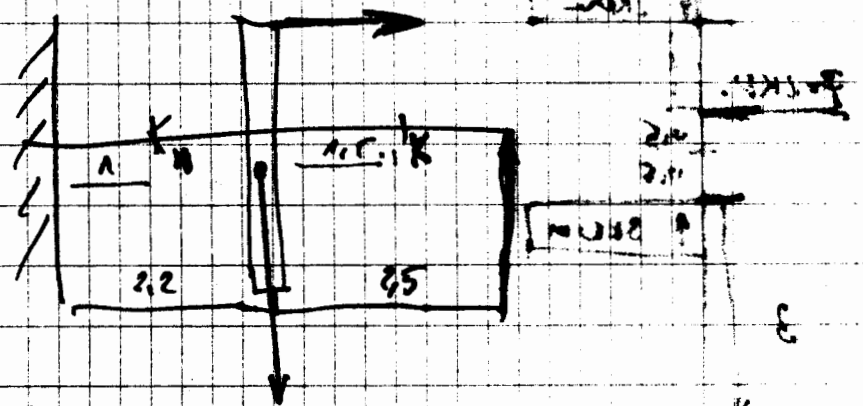
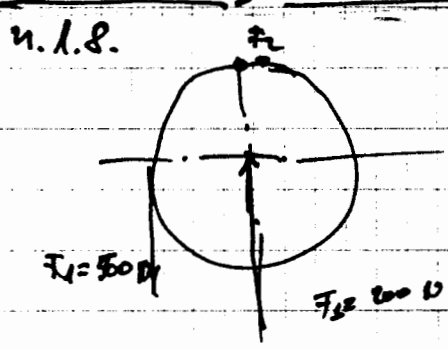
N +  
T +  
P +



$N = 0$   
 $T = 600 \text{ N}$   
 $M = 600 \cdot 1.1 = 660$   
 $M_A = 0$   
 $M_Ax = 400$

$\sum \vec{V} = 0 \Rightarrow V_A = 0$   
 $\sum \vec{M} = 0 \Rightarrow M_A = 3180 \text{ Nm} \leftarrow M_Ax = 400$

$K_2$   
 $N = 0$   
 $T = 1000 \text{ N}$   
 $M = 2380$   
 $N_{CS} = 40 \Rightarrow$



4.1.3

Σ MA = 0

$$0 = M_A + 500 \cdot 2.2 - 4.7 \cdot 200$$

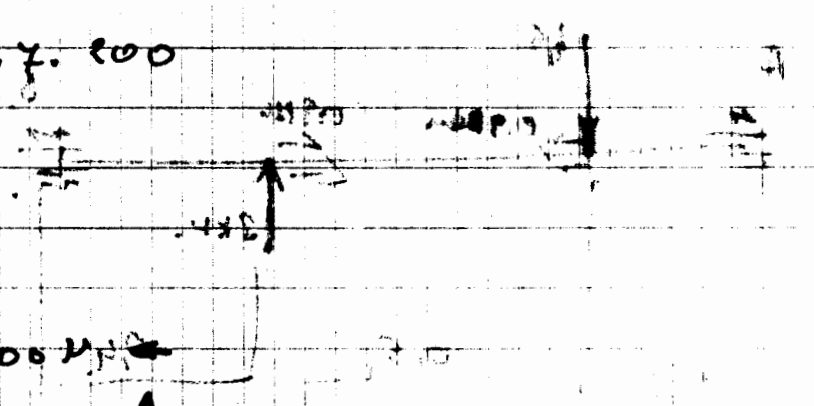
$$M_A + 160 = 0$$

$$M_A = -160 \text{ kJ}$$

$$\Rightarrow M_A = 500 \text{ Nm}$$

$$\sum X_i = 0 \Rightarrow R_x = 200 \text{ N}$$

$$\sum Y_i = 0 \Rightarrow R_y = 300 \text{ N}$$



$X_1$

$$V = 200 \text{ N} \leftarrow$$

$$T = 300 \text{ N} \uparrow$$

$$\sum M_i = -160 + 1.1 \cdot 300$$

$$\sum M_k = 170 \text{ kN}$$

$$M_{CS} = 500 \text{ kNm}$$

$X_2$

$$V = 0$$

$$T = 200 \text{ N} \downarrow$$

$$\sum M_i = 200 \text{ Nm}$$

$$M_{CS} = 0$$

$$= 160 + 3.7 \cdot 300$$

$$= 117.500$$



4.1.3

Σ MA = 0

$$0 = M_A + 500 \cdot 2.2 - 4.7 \cdot 200$$

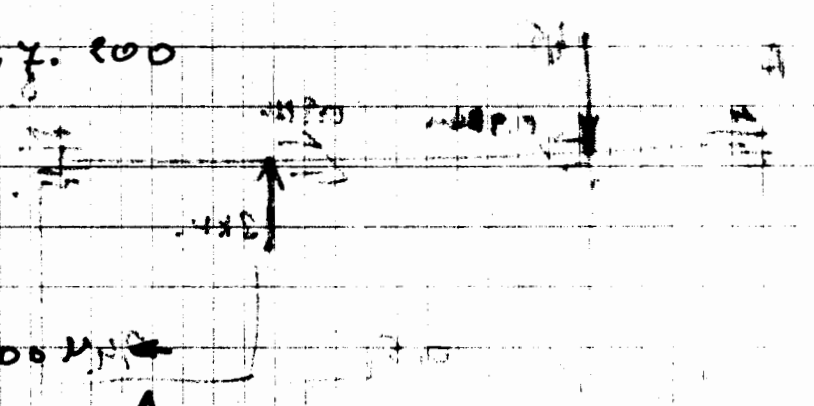
$$M_A + 160 = 0$$

$$M_A = -160 \text{ kJ}$$

$$\Rightarrow M_A = 500 \text{ Nm}$$

$$\sum X_i = 0 \Rightarrow R_x = 200 \text{ N}$$

$$\sum Y_i = 0 \Rightarrow R_y = 300 \text{ N}$$



$X_1$

$$V = 200 \text{ N} \leftarrow$$

$$T = 300 \text{ N} \uparrow$$

$$\sum M_i = -160 + 1.1 \cdot 300$$

$$\sum M_k = 170 \text{ kN}$$

$$M_{CS} = 500 \text{ kNm}$$

$X_2$

$$V = 0$$

$$T = 200 \text{ N} \downarrow$$

$$\sum M_i = 200 \text{ Nm}$$

$$M_{CS} = 0$$

$$= -160 + 3.7 \cdot 300$$

$$= 41.500$$

# IV Temadan

2.2.2

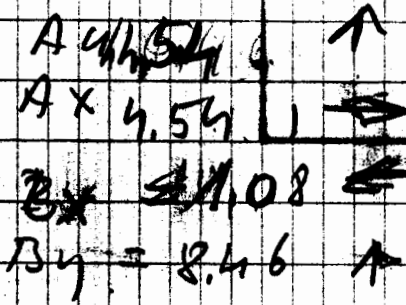
4.1.

$Q = 8 \text{ kN}$

$q_1 = 3 \text{ kN}$

$f_{2x} = 3,464 \text{ kN}$

$2_2y = 2 \text{ kN}$

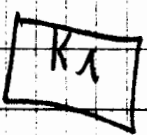


$\sum \mathcal{M}_1 = 0 = 3 - 2 \cdot 8 + 4,5 \cdot 3,4 - 6 \cdot 3 - 7 \cdot 2 + 2 \cdot 3,464$

$\sum Y_i = 0 = A_y - 8 + 8,46 - 3 + 2$

$A_y = 4,54$

$\sum X_i = 0 = 1,08$



$N = -4,54 \text{ kN}$   
 $T = 1,08 \text{ kN}$

$\sum \mathcal{M} = 2 \cdot 4,54 - 1 \cdot 4 - 3 \cdot 6$   
 $\rightarrow 2,08 \text{ kNm}$

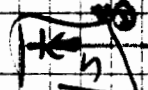


$N = -3,46$

$T = 5 \uparrow$

$\sum \mathcal{M} = 5,5 \cdot 6,54 - 3 - 8 \cdot 3,5 + 1 \cdot 8,46$

$\sum \mathcal{M} = 2,63$



$N = -4,54 \text{ kN}$

$T = \downarrow 3,46$

$M = 4 \cdot 4,54 - 2 \cdot 8 - 3 \cdot 6$

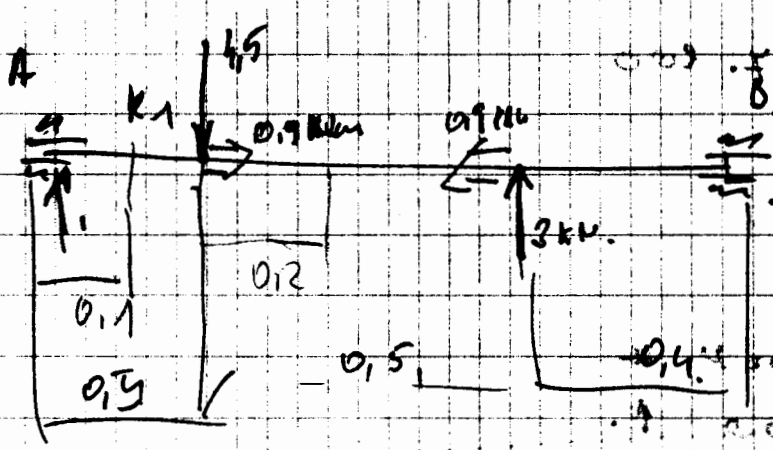
$\rightarrow 0,84$

$N = 2$

$T \downarrow 3,46$

$\sum \mathcal{M} = 5,19$

4.1.91



$$\sum M_{K2} = 0 = 0.3 \cdot 4.5 - 0.8 \cdot 3 + 3 \cdot 1.2$$

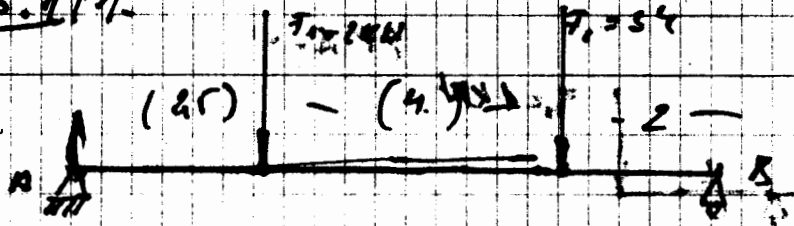
$$\downarrow R_3 = 0.875 \text{ kN}$$

$$\uparrow H_3 = 0.675$$

**K1**  $N = 0$   
 $T = 0.1675$   
 $M = 0.0675 \text{ kNm}$   
 $M_{CS} = 0$

**K3**  $V = 0$   
 $T = \sqrt{3.875}$   
 $M = 0.3 \cdot 0.675 - 0.2 \cdot 4.5$   
 $M = -0.7125$   
 $M_{CS} = 0.93125$

S.1.1

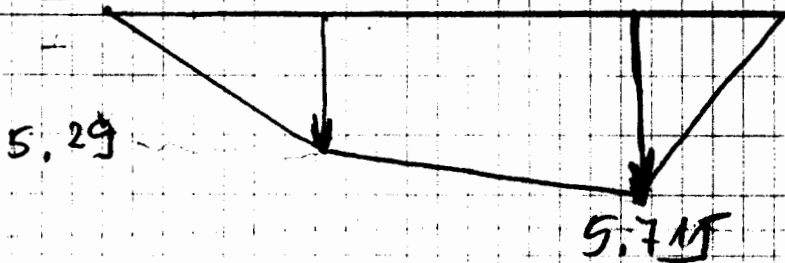
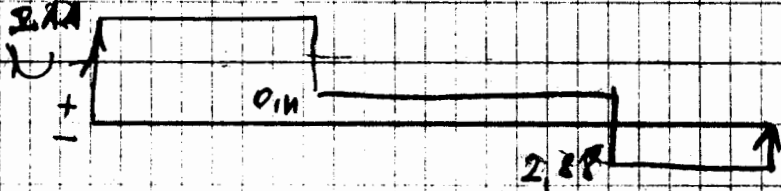


$\sum M_A = 0 <$

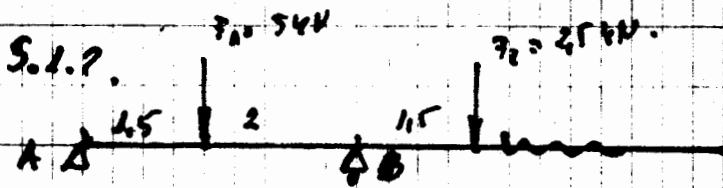
$= 2.5 \cdot 2 + 0.5 \cdot 5 - 5.5 \cdot B$   
 $B = 2.88$

$\sum F_y = 0 = A_y = 2.88$

$A_x = 0$



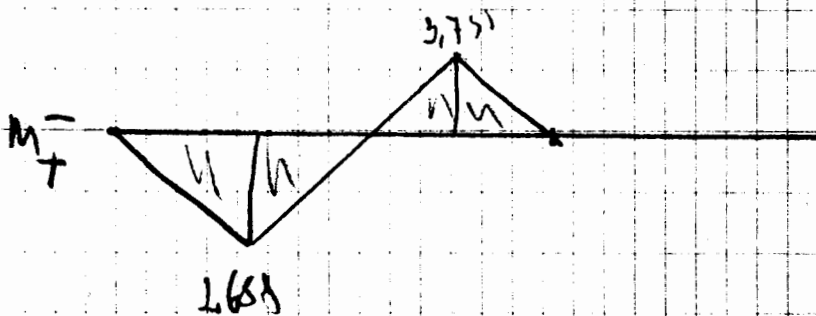
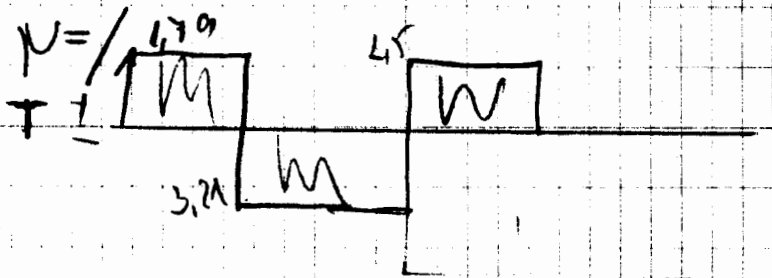
S.1.2



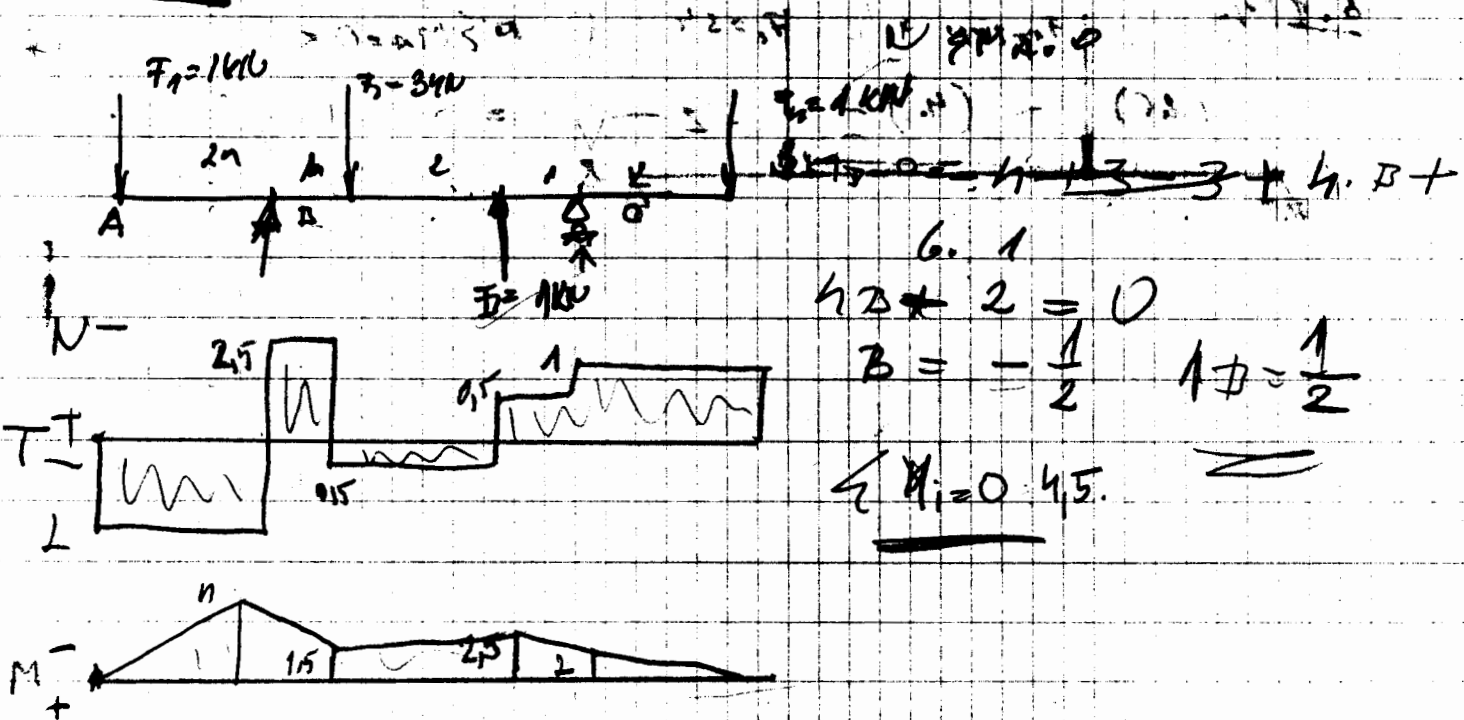
$\sum M_A = 0 = 4.5 \cdot 5 - 3.5 \cdot B + 5.25$

$B = 5.77$

$\sum F_y = 0 = A_y = 5.77$

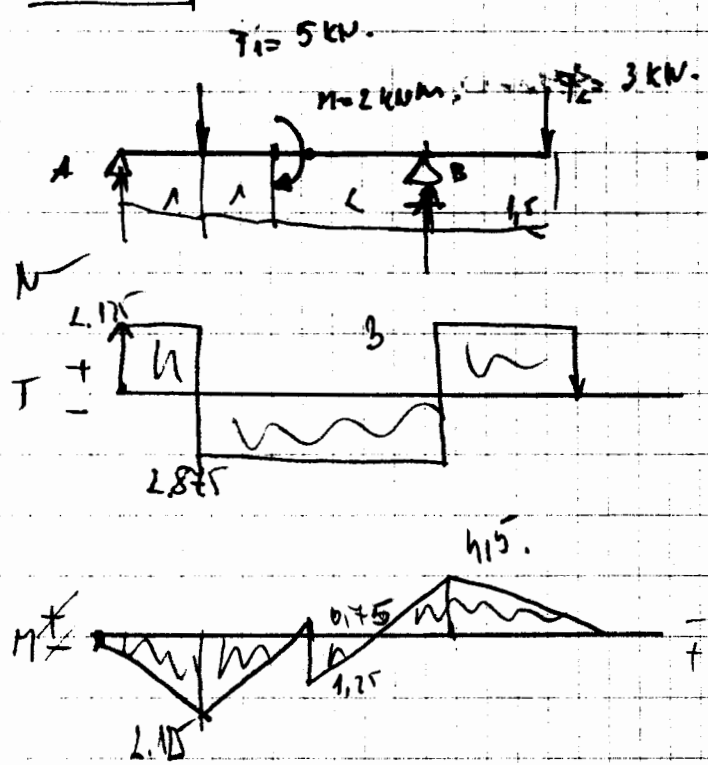


5.1.3



$h_2 + 2 = 0$   
 $B = -\frac{1}{2}$   
 $A + B = \frac{1}{2}$   
 $\Rightarrow A = 0.75$

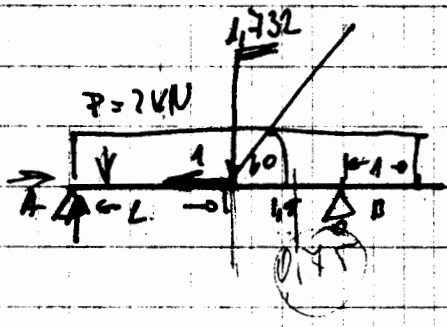
5.1.4



$\sum M_A = 0$   
 $A + B = 5.875$   
 $\Rightarrow A = 2.125$   
 $\Rightarrow B = 3.75$

5.1.5

$\leftarrow 4,5 \text{ kN} \rightarrow$   
 $Q = 9 \text{ kN}$

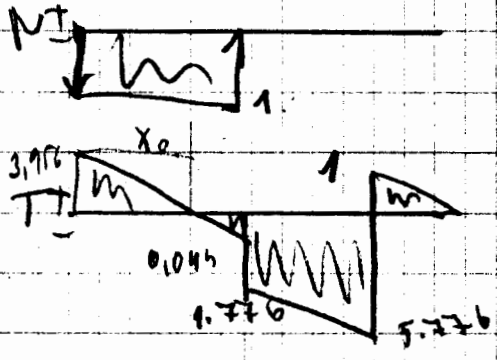


$\sum M_A = 0 = 2 \cdot 1.732 + 2.25 \cdot 9 - 3.5 \cdot 3$

$\uparrow B = 6.775$

$\leftarrow \sum X = 0 \rightarrow A_x = 3.956 \text{ kN}$

$\sum Y = 0 \quad A_y = -1 \text{ kN}$

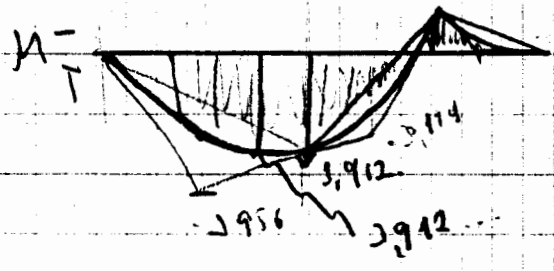


$A - B X_0 = 0$

$\frac{3.956}{2} = X_0 = 1.978$

$\sum M = X_0 \cdot 2.176 - \frac{8 \cdot 1.978^2}{2}$

$M = 3.912 \text{ kNm}$



$+ 25 - 21.9 - 0.9 = 4$

5.1.6

$\sum M_A = 0$

$= 10 - 0.9 \cdot 8 - 18 - 7B$

$+ 3 = 2.1 - 7B$

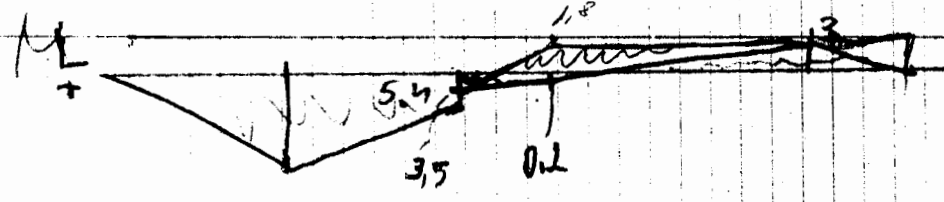
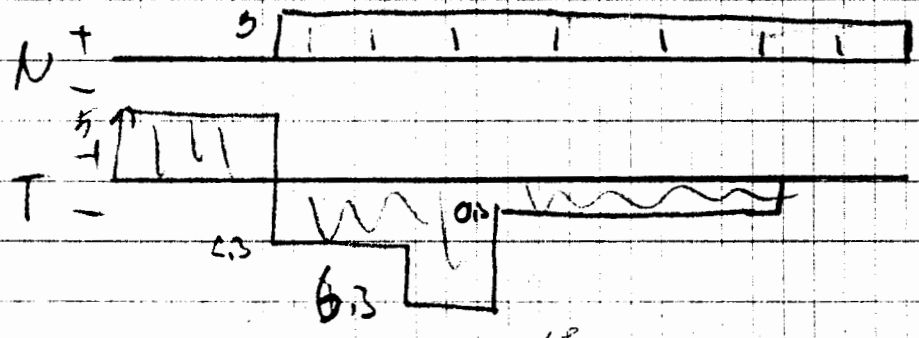
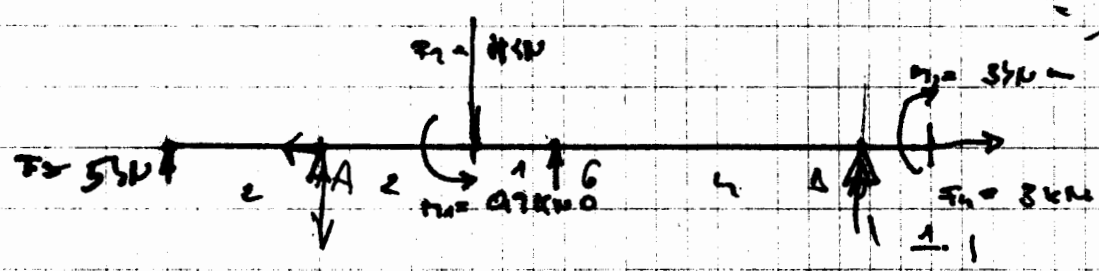
$B = 0.13 \text{ kN}$

$\sum X = 0 \quad \downarrow A_y = 73$

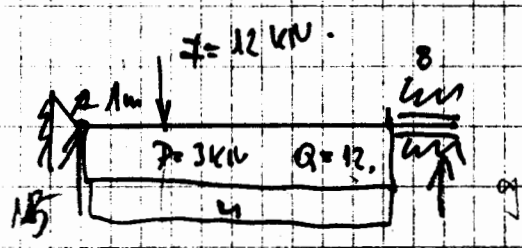
$\sum Y = 0 \quad \leftarrow A_x = 38$

$M_B = 45 - 51.1 - 0.1$

$- 20 + 21.1 = -3$



5.1.7.



$$\sum M_A = 0 \Rightarrow 2 + 12 \cdot 3 + 4 \cdot 3 \cdot \frac{3}{2} - 8 \cdot 6 = 0$$

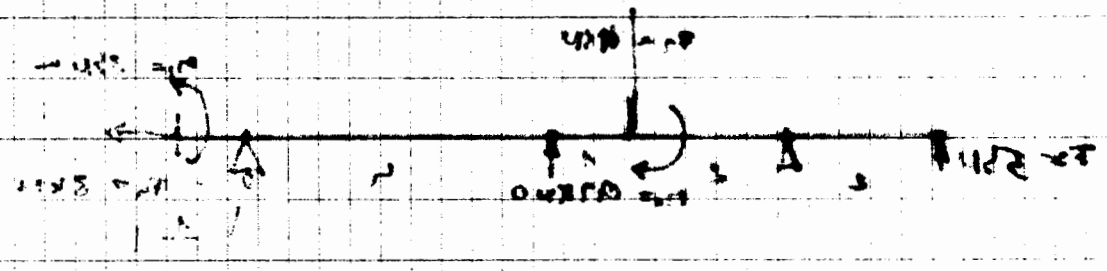
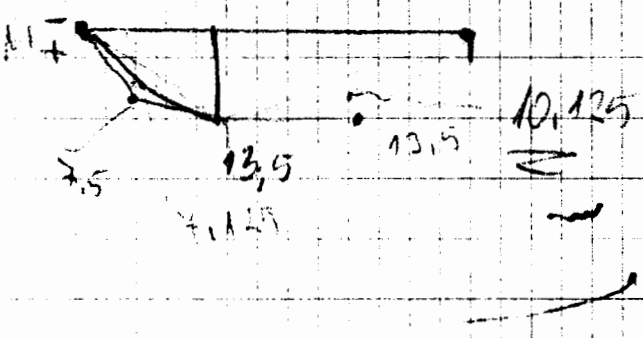
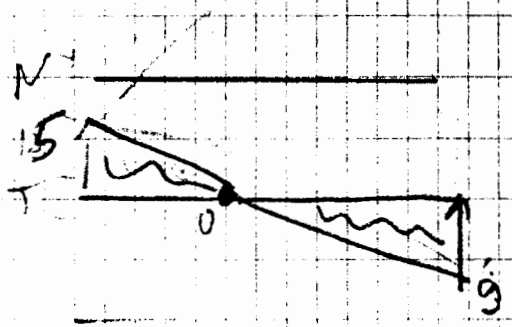
$$2 + 36 + 18 - 48 = 0$$

$$12 = 0$$

$$\sum V = 0 \Rightarrow 15 - 12 - 4 \cdot 3 + 8 = 0$$

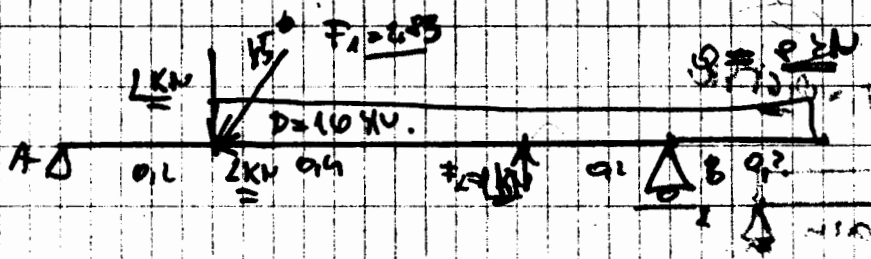
$$15 - 12 - 12 + 8 = 0$$

$$-1 = 0$$

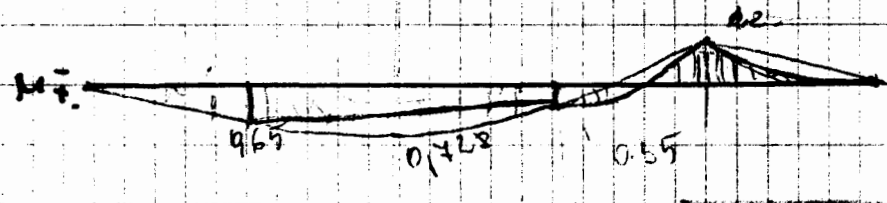
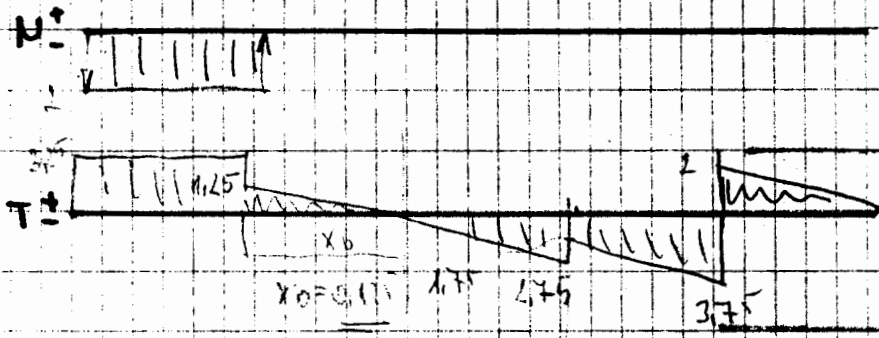




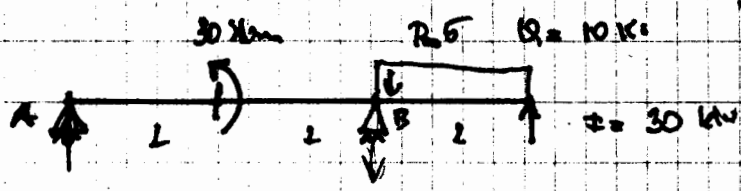
5.1.10



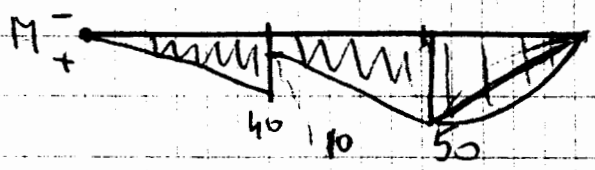
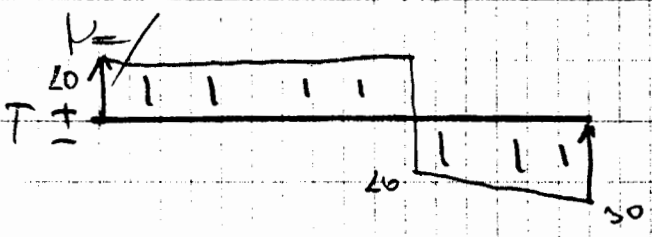
$\sum \uparrow M_A = 0 = 0.2 \cdot 2 + 8 \cdot 0.6 -$   
 $\sum \uparrow R_B = 0 = 1.0 \cdot 2 + 2 \cdot 0.4 - 2 \cdot 1.0$   
 $\sum \rightarrow H = 0 = 2 \cdot 1.0 - 2 \cdot 1.0$   
 $\sum \uparrow V = 0 = 2 \cdot 1.0 - 2 \cdot 1.0$



5.1.11.



$\sum \uparrow M_A = 0 = 30 + 4 \cdot B_y + 5 \cdot 10 - 6 \cdot 30$   
 $\downarrow B_y = 50 \text{ kN}$   
 $\sum \uparrow V = 0 \rightarrow A_y = 20 \text{ kN}$   
 $\sum \rightarrow H = 0 \rightarrow A_x = 0$



1.25  
 2.25  
 30

5.1.P

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nou amieff  
a no wout.

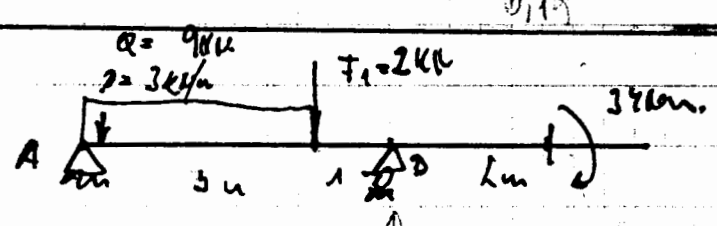
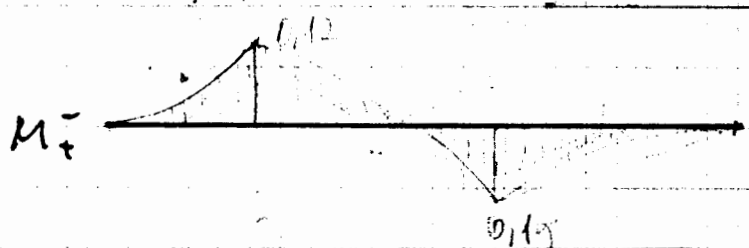
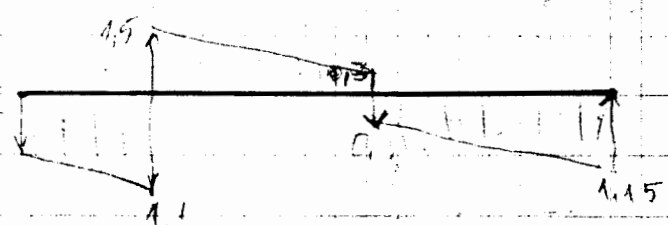
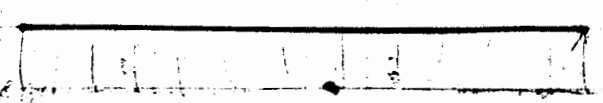
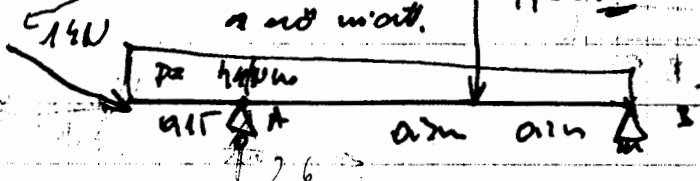
$$\sum M_{O} = 0 = 0,5 \cdot 0,65 + 0,5 \cdot A_{11} -$$

$$= 2,6 \cdot 0,775 - 0,117$$

$$A_{11} = 2,6$$

$$\sum u = 0 = B_{11} = 1,15$$

$$\sum k_i = 0 \Rightarrow v = 0,85$$

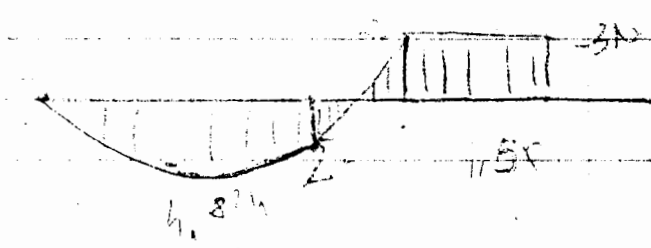
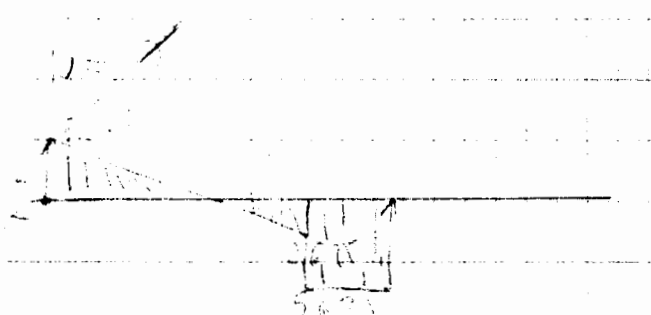


$$\sum M_{O} = 0 = +3 \cdot 1,5 + 3 \cdot 1,2 - 4 \cdot 2$$

$$\sum F_{y} = 0 = A + B - 5,31$$

$$\sum X_i = 0 \Rightarrow A \cdot X = 0$$

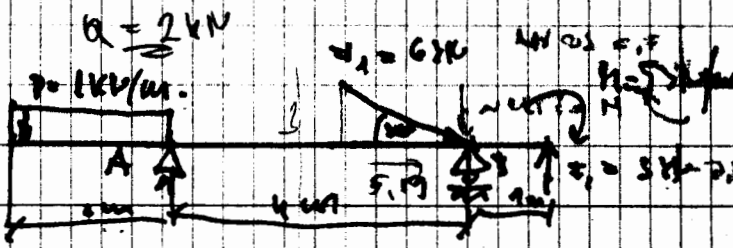
$$A = 1,77$$



5.1.12

$$\sum F_x = 0 \Rightarrow 5 - 5 = 0$$

$$\sum M_A = 0 \Rightarrow -2 + 4 \cdot 3 + 5 - 5 \cdot 3 - 4 \cdot 3 = 0$$

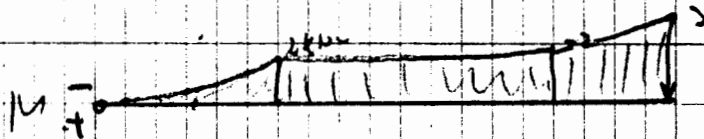
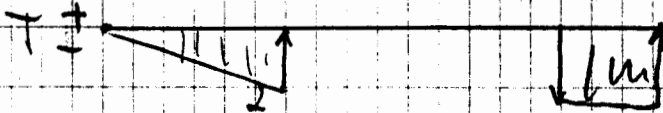


$$\sum F_y = 0 \Rightarrow A_y = 2 \text{ kN}$$

$$\sum F_x = 0 \Rightarrow A_x = 5, x = 5.19$$

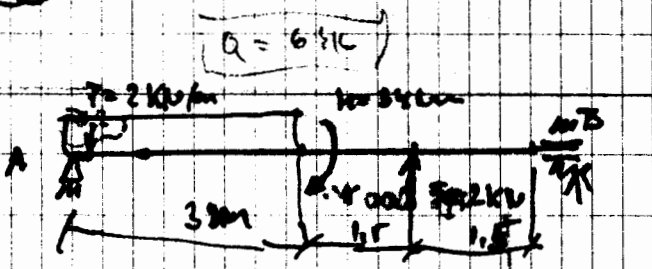


$$-12 + 10 = -3$$



5.1.13

(52)



$$\sum M_A = 0 \Rightarrow 1.5 \cdot 6 + 3 - 4.5 \cdot 2 - 6 \cdot 0 = 0$$

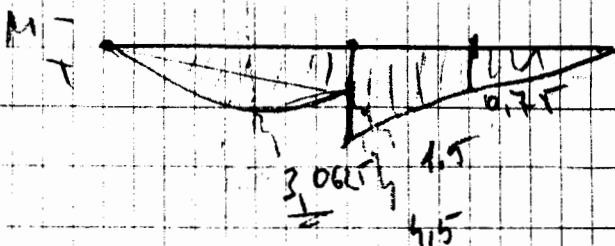
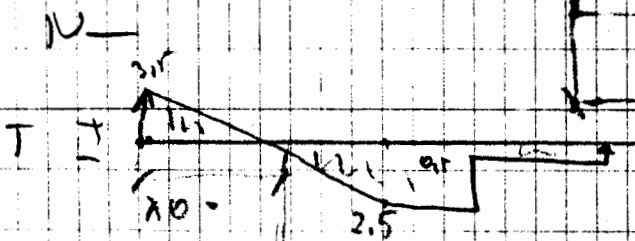
$$\sum F_y = 0 \Rightarrow A_y = 0.5 \text{ kN}$$

$$\sum F_x = 0 \Rightarrow A_x = 3.15 \text{ kN}$$

$$\sum M_B = 0 \Rightarrow A_x = 0, D_x = 0$$

$$A = \frac{P \cdot x_0}{D}$$

$$x_0 = \frac{2.17}{2} = 1.085$$



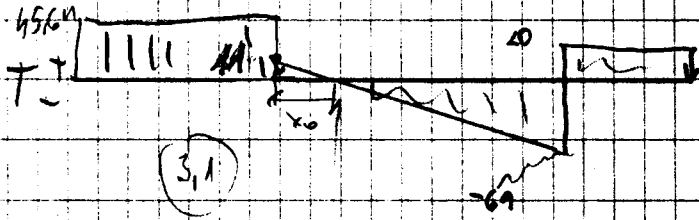
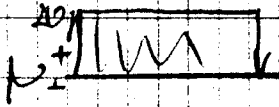
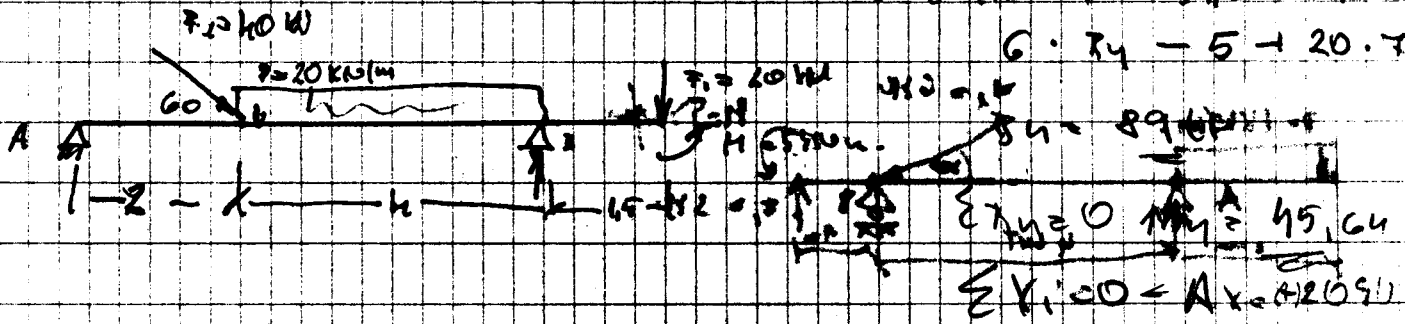
5.1.14

$Q = 80 \text{ kN}$

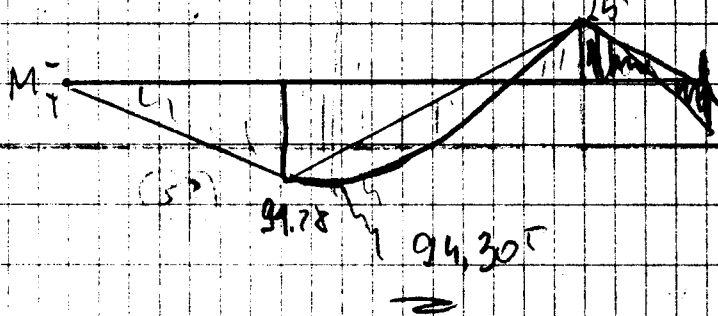
$F_{ix} = 20$   
 $F_{iy} = 34,64$

106 11.17

$\sum M_A = 0 \Rightarrow 2 \cdot 34,64 + 4 \cdot 80 - 6 \cdot R_y - 5 = 20 \cdot 7,5 = 0$

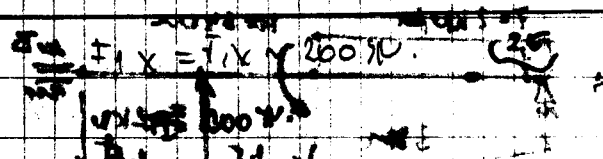


$x_0 = \frac{M}{20} = 0,55$

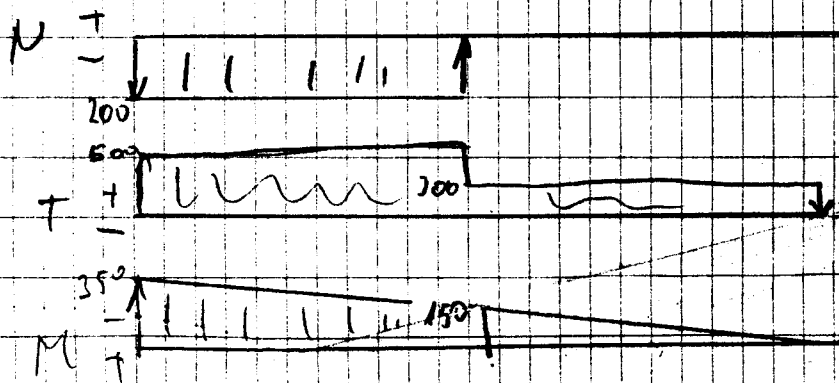
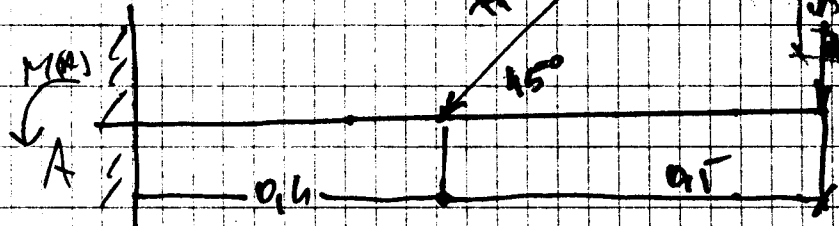


11.2

5.1.15



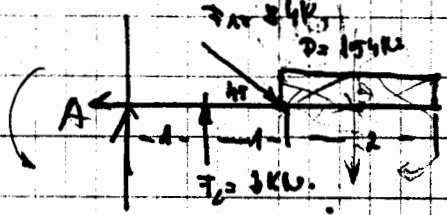
$\sum M_A = 0 \Rightarrow 0,4 \cdot 200 + 0,9 \cdot 150 - 100 - M_A = 0$   
 $M_A = 350 \text{ Nm}$   
 $\sum Y_i = 0 \Rightarrow \uparrow A_y 500$   
 $\sum X_i = 0 \Rightarrow \rightarrow A_x = 200$



5.1.16

$Q = 50 \text{ kN}$

$F_{1x} \rightarrow$   
 $F_{1y} \downarrow$   
 $5.65 \text{ kN}$

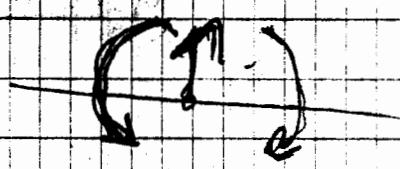
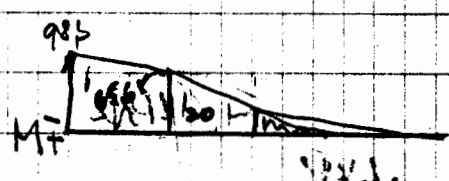
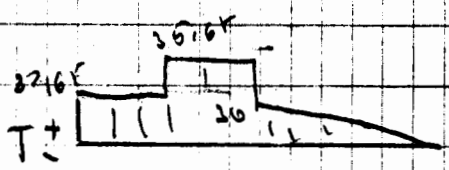
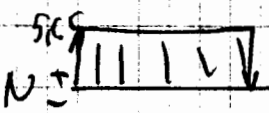


$\sum M_A = 0 \Rightarrow -3 + 2 \cdot 5.65 - 3 \cdot 30 - M_A = 0$

$M_A = 98.3 \text{ kNm}$

$\sum X_i = 0 \Rightarrow A_x = +5.65 \text{ kN}$

$\sum Y_i = 0 \Rightarrow \uparrow A_y = 32.65 \text{ kN}$



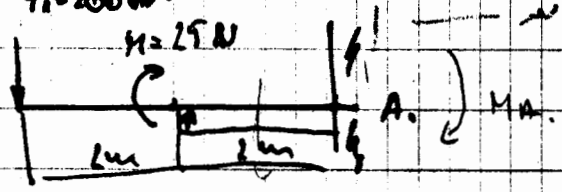
$-98.3 + 32.65 \cdot 3 + 6 - 5.65 \cdot 1$

5.1.17

$q = 200 \text{ N/m}$   
 $P = 400 \text{ kN}$

$F_1 = 200 \text{ kN}$

$M = 25 \text{ kNm}$

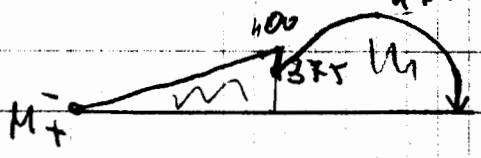
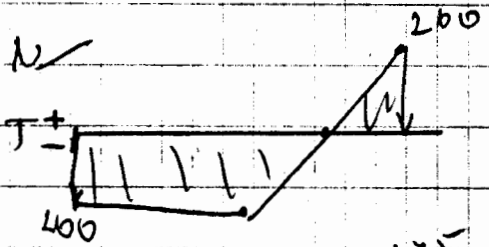


$\sum M_A = 0 \Rightarrow -1 \cdot 200 + 25 + 400 + M_B = 0$

$M_B = 3.75$

$\sum Y_i = 0 \Rightarrow A_y = \downarrow 200$

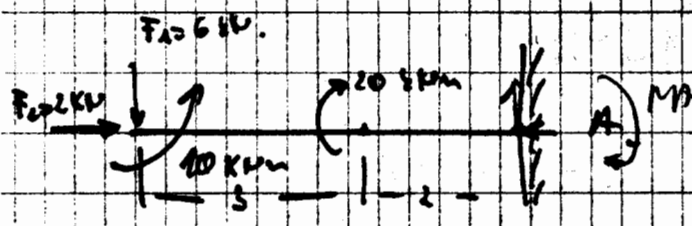
$\sum X_i = 0 \Rightarrow A_x = 0$



$600 - 100 - 25$

S.1.18

172

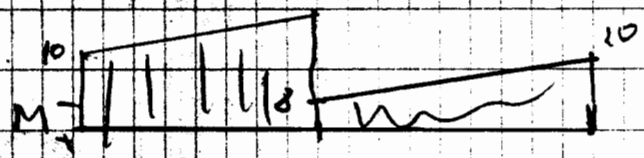
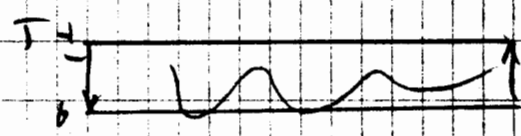
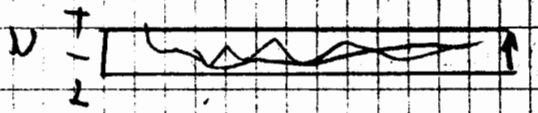


$$\sum \text{MA} = 0 \Rightarrow -5 \cdot 6 + 20 + 20 + M_A = 0$$

$$\sum \text{MA} = M_A + 20 = 0$$

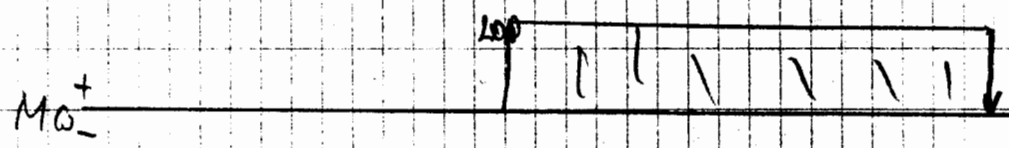
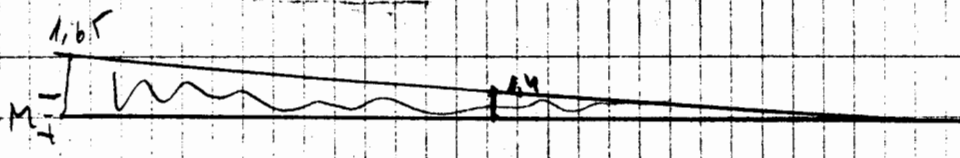
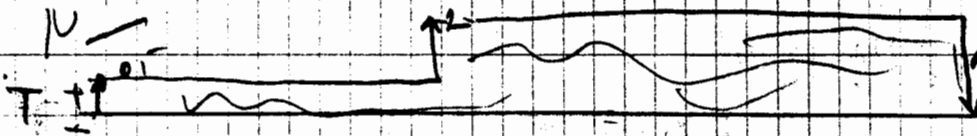
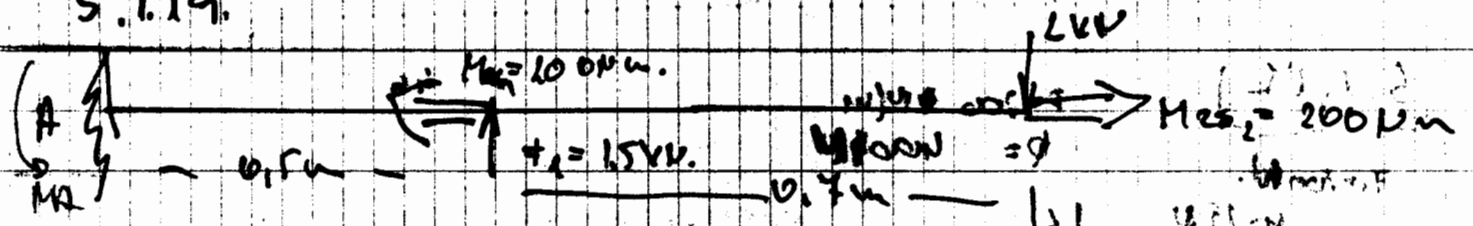
$$\sum X_i = 0 \Rightarrow A_x = +2 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow A_y = 6 \text{ kN}$$



S.1.19

de 1000 15



$$\sum \text{MA} = 0 \Rightarrow 0.5 \cdot 1.5 + 2 \cdot 0.7$$

$$\sum \text{MA} = 0$$

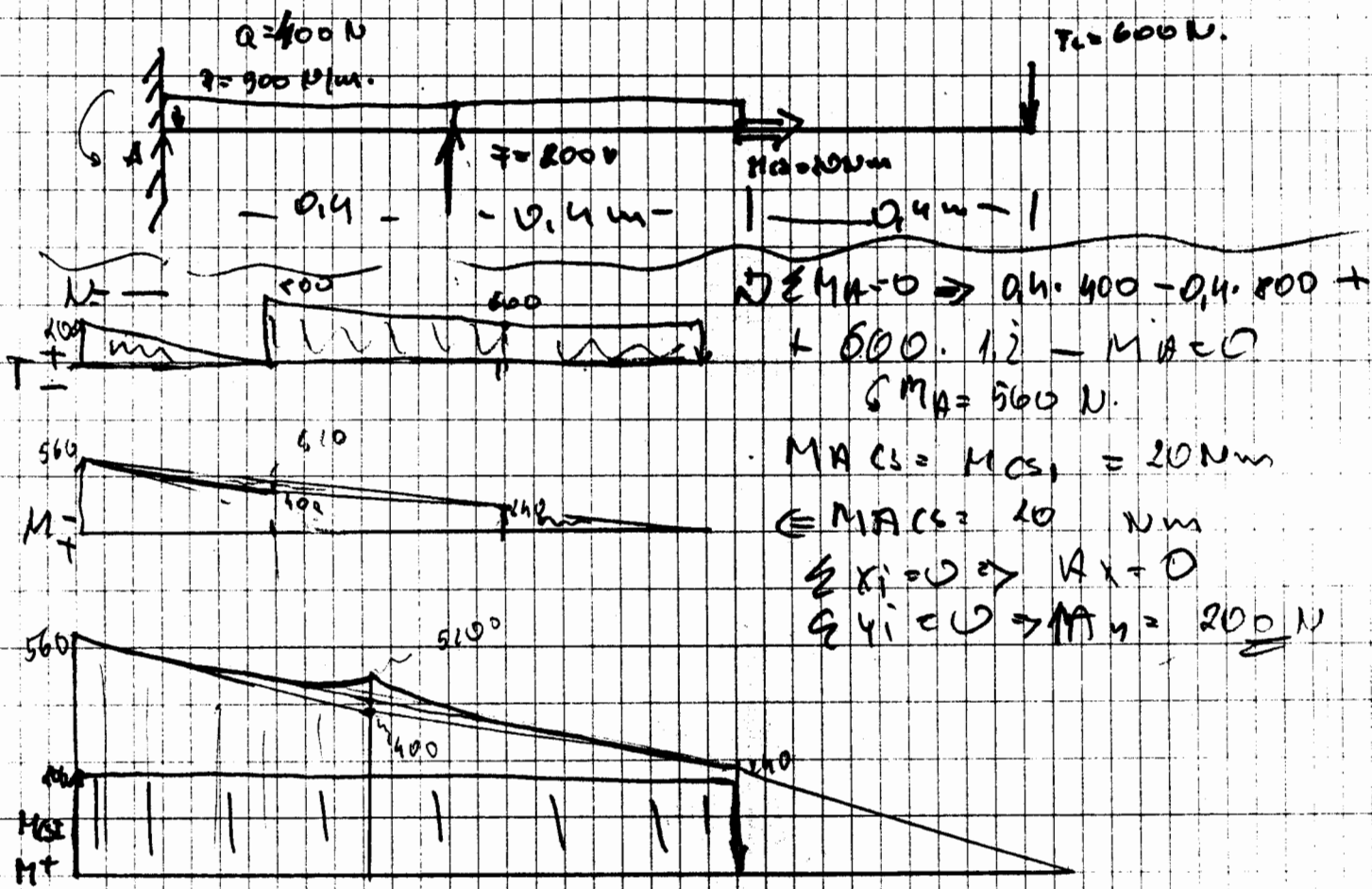
$$M_A = 1.65$$

$$\sum Y_i = 0 \Rightarrow A_y = 0$$

$$\sum X_i = 0 \Rightarrow A_x = 0.5 \text{ kN}$$

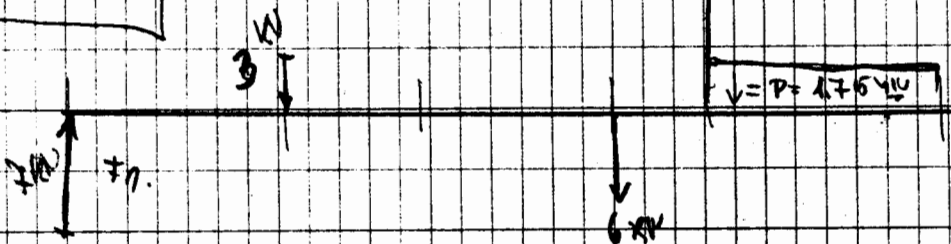
S.1.20

(1P)



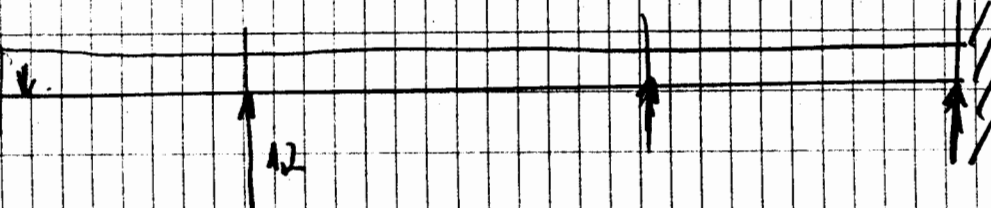
$A_4 = P \cdot 0,18$

S.2.1



$$\frac{F}{X} = \frac{P \cdot Y}{P}$$

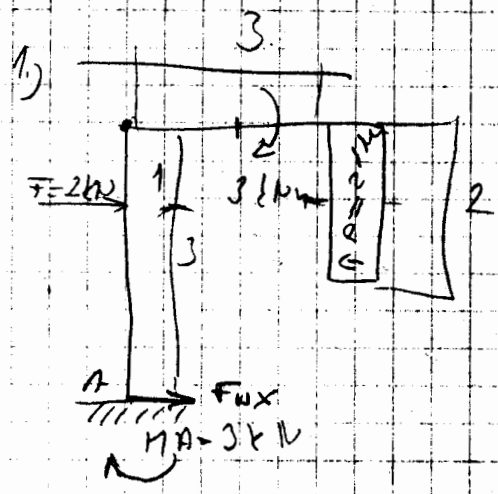
S.2.2



$F = 0,11 \cdot l = 1,1 \text{ m}$   
 $P = 0,36 \dots \text{ Nm}$   
 $\frac{5}{12}$



Wurmi web.



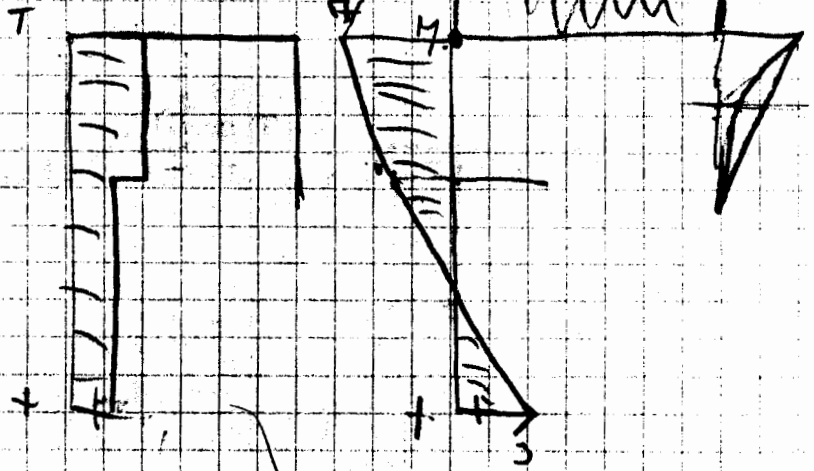
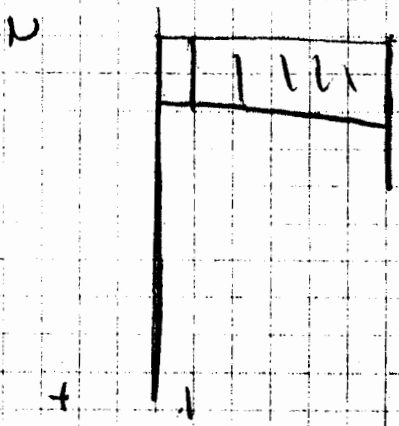
$$\sum M_A = 0 = M_A + 6 + 3 - 12$$

$$M_A = 3 \text{ kNm}$$

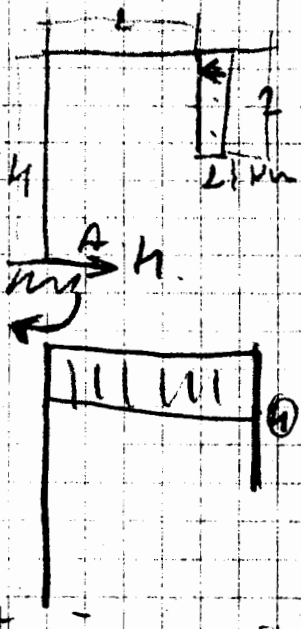
$$+ \uparrow \sum Y_i = 0 = A_y$$

$$\Rightarrow 2Y_i = A_y + 2 - 4 = 0$$

$$A_y = 2$$

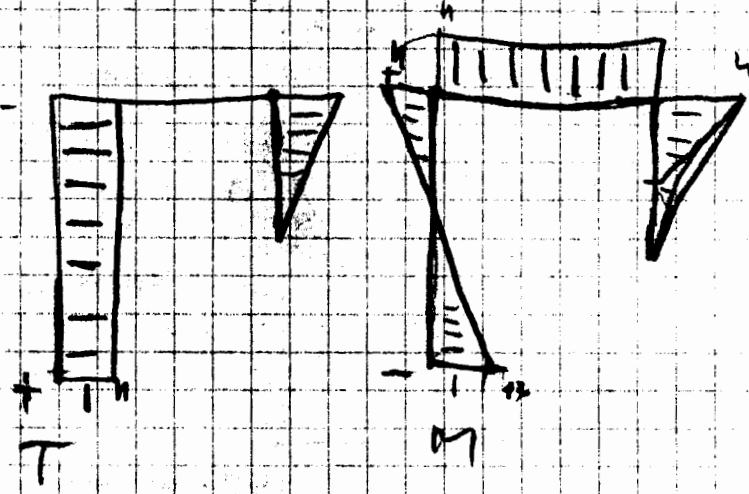
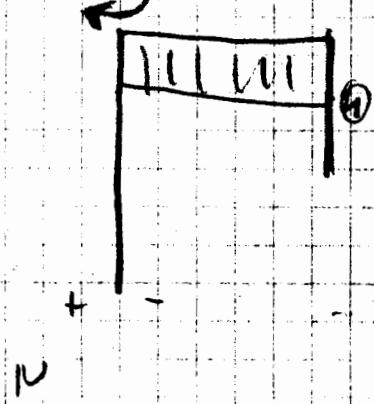


6.1.1



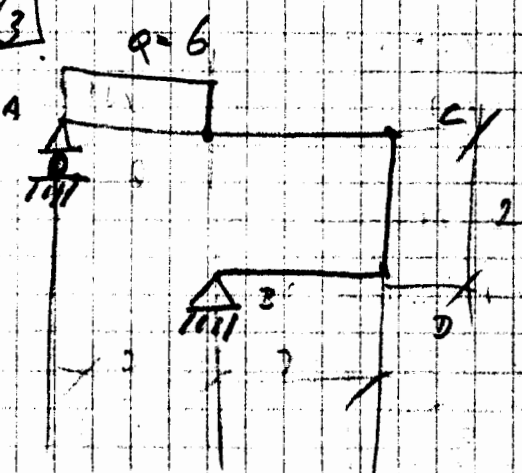
$$\sum M_A = 0 = A - 3 \cdot 4 = 0$$

$$A = 12$$



12 Eo'v  
 61/3

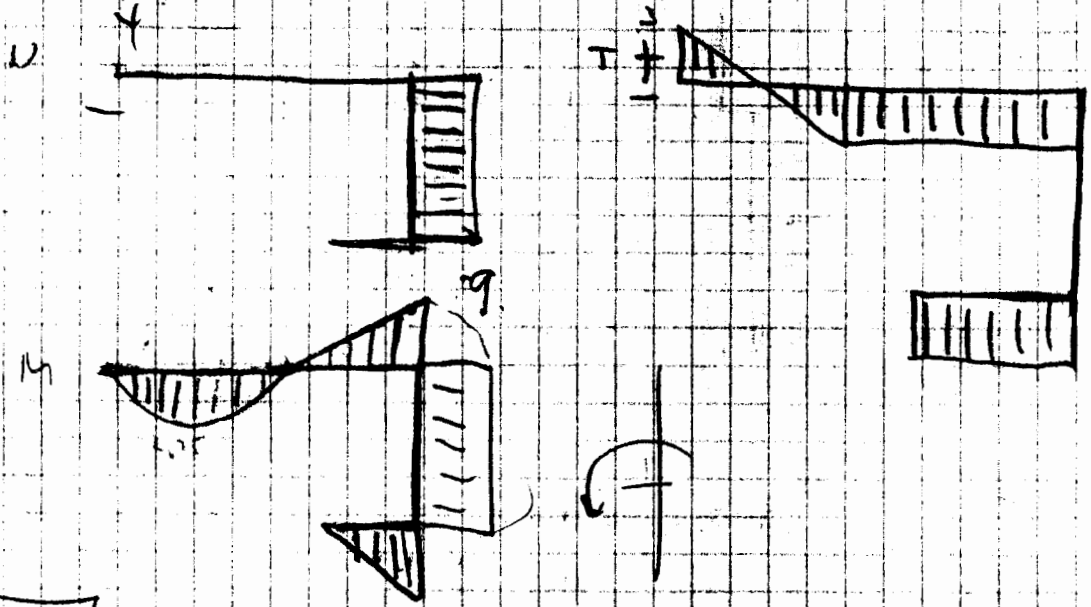
1.  $\frac{1}{2} \times 18$



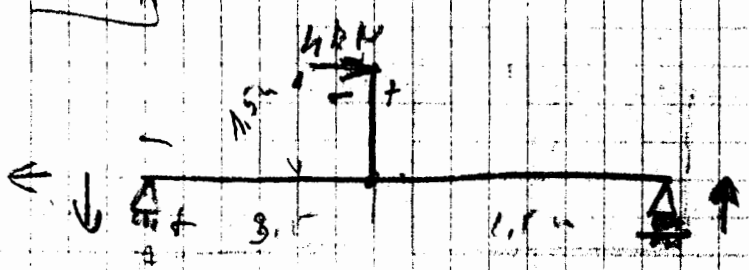
$\sum \mathcal{M}_B = 0 \rightarrow 15 \cdot 6 + 3 \cdot A$

$A = 3 \text{ k}$   
 $A_{ux} = 3 \text{ k}$

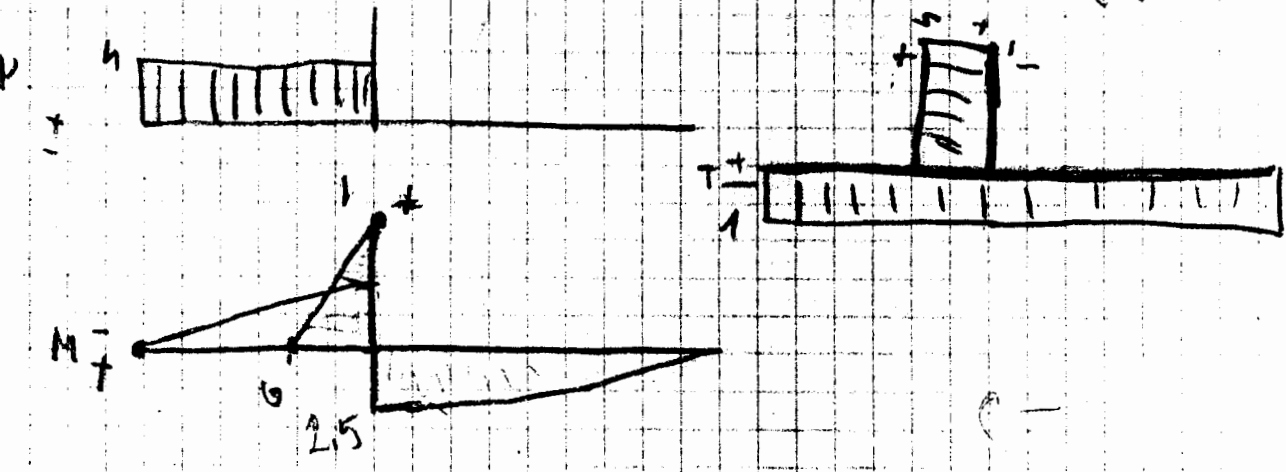
$\sum V = 0 \rightarrow 3 - 6 + B_y = 0$   
 $B_y = 3$



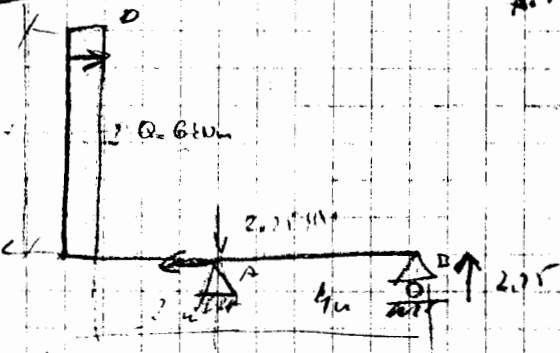
614



$\sum \mathcal{M}_A = 0 = 6 - 6B_y$   
 $B_y = 1 \text{ kN}$   
 $B_{Ax} = 4 \text{ kN}$   
 $\leftarrow A_x = 4 \text{ kN} (+)$



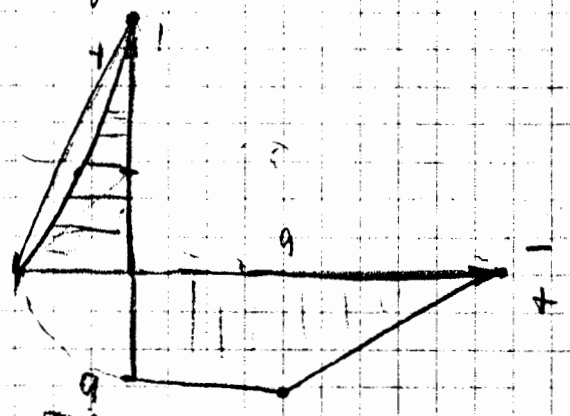
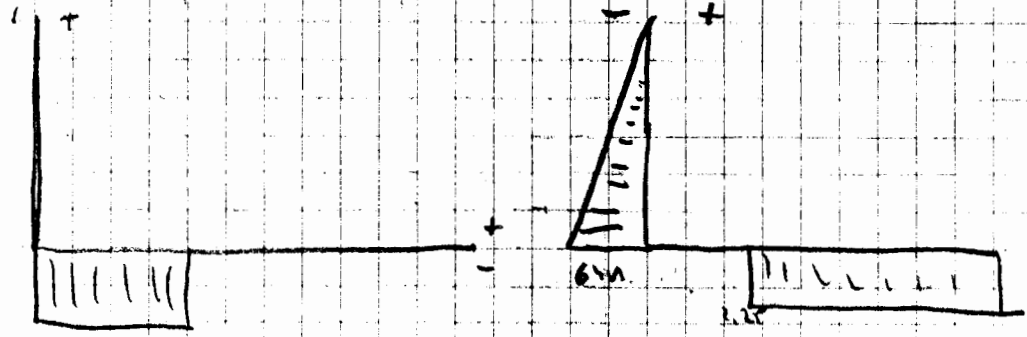
6 1.5



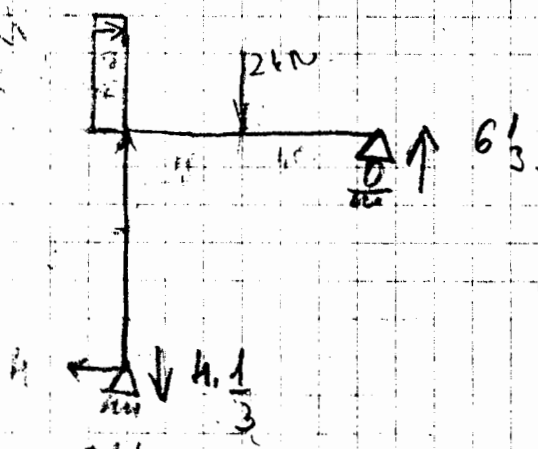
$\sum M_B = 0 = 2.25 \cdot 4 - X \cdot 6$

$X = 2.25 \cdot \frac{4}{6} = 1.5 \text{ kN}$

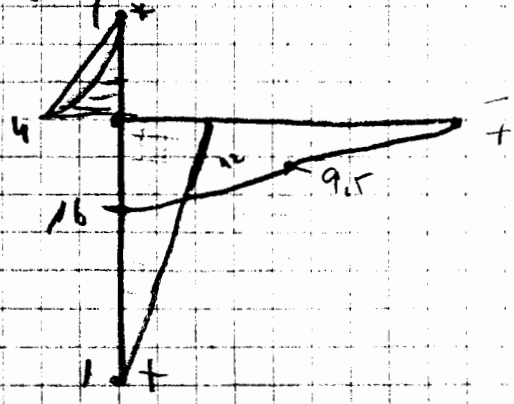
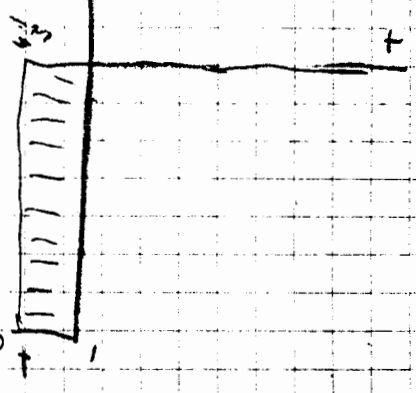
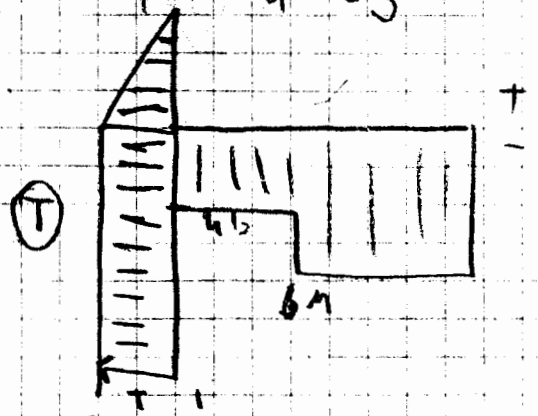
$\sum F_{Ay} = 2.25$   
 $\sum F_{Bx} = 1.5 \text{ kN}$



6 1.5

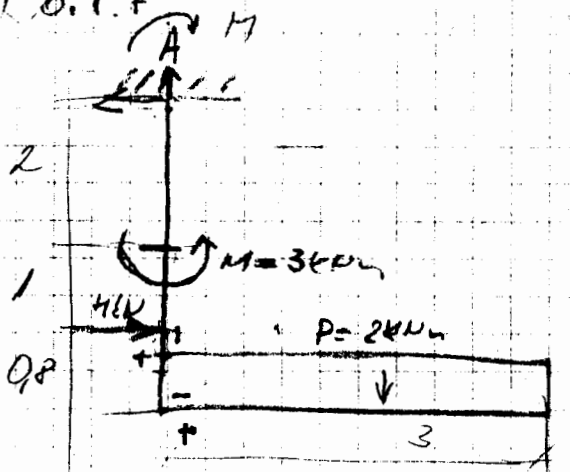


$\sum M_B = 0 = 2 \cdot 6 + 3 - 3 \cdot B_y$   
 $B_y = 6 \frac{1}{3} \text{ kN}$



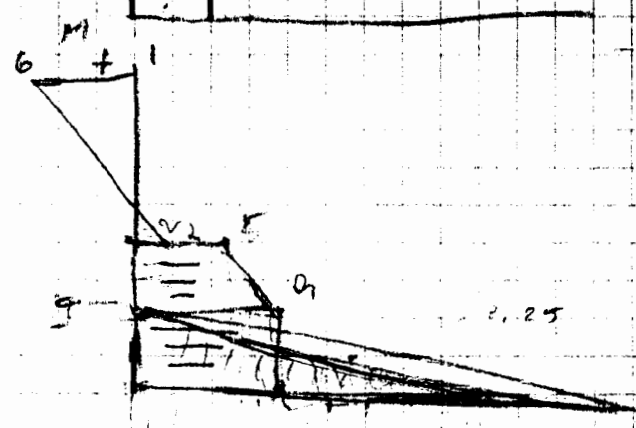
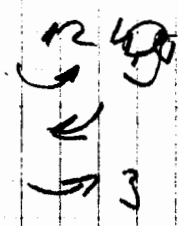
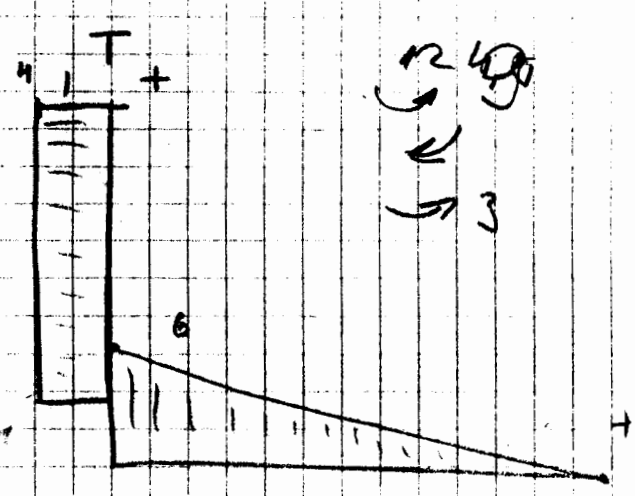
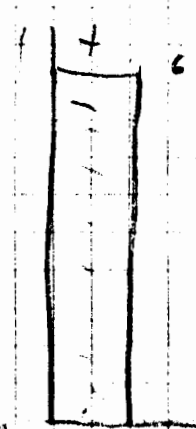
(N)

6.17



$\sum M_A = 0 = M_A - 3 - 12 + 9$   
 $M_A = 6 \text{ kNm}$   
 $\leftarrow M_{\text{MAX}} = 12 \text{ kNm}$   
 $\uparrow M_{\text{MIN}} = 6 \text{ kNm}$

15.1



$6 - 3 \cdot 4 - 3 + 3 \cdot 4$   
 $- 12 - 3$   
 $6 - 3 \cdot 1 - 3 + 0$

12.4

6.18

$Q = 800$   
 $800$

$Q = 800 \frac{\text{kg}}{\text{m}^3}$   
 $P = 800 \frac{\text{kg}}{\text{m}^3}$

6.1.1

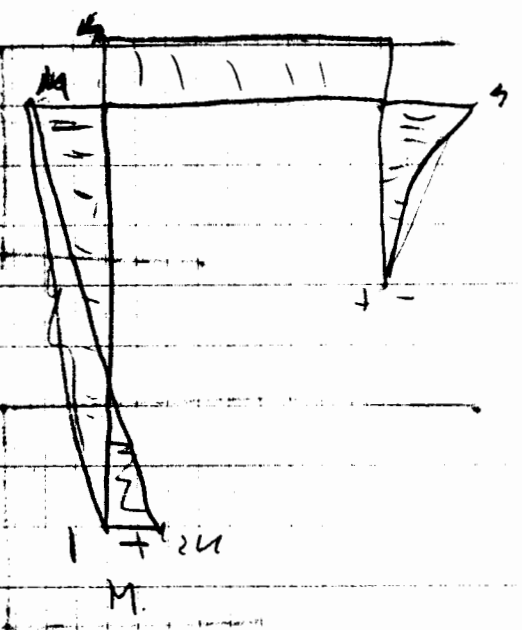
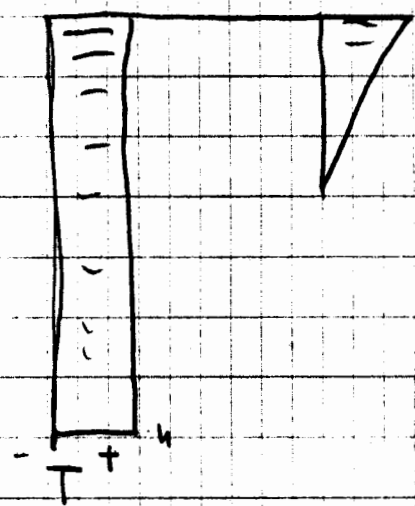
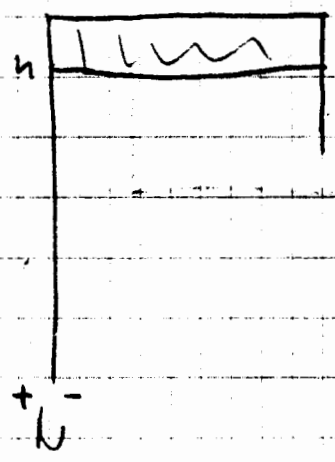
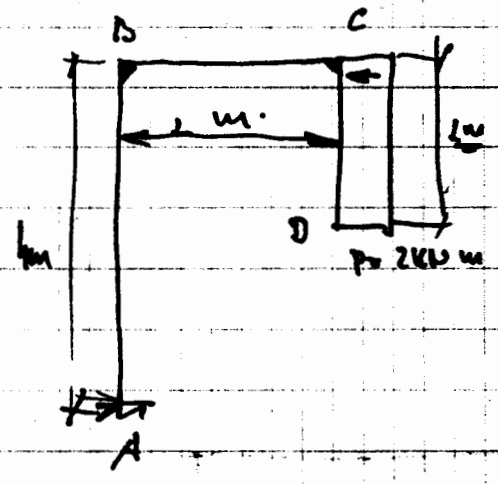
$Q = 4 \text{ kN}$

$\sum M_A = 0 \Rightarrow -h \cdot 3 + MA = 0$

$MA = 12 \text{ kN}$

$\sum Y = 0 \Rightarrow AY = 0$

$\sum X = 0 \Rightarrow AX = 4 \text{ kN}$



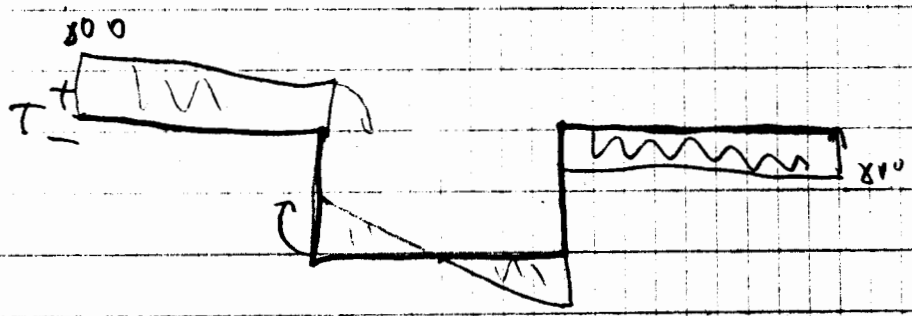
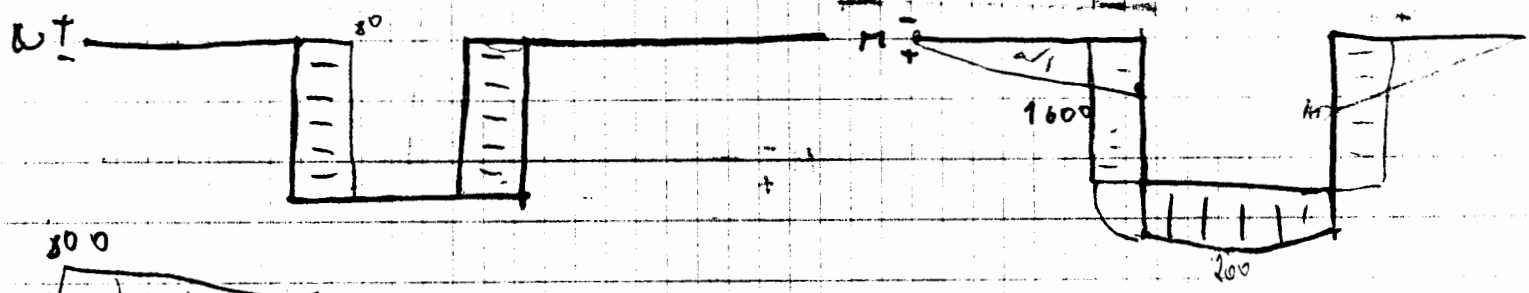
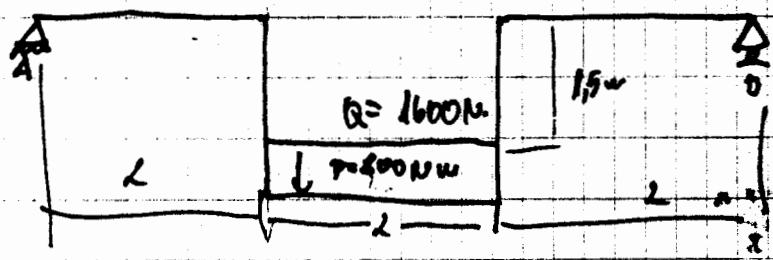
6.1.2.

$\sum M_A = 0 \Rightarrow 3 \cdot 1600 - G \cdot P = 0$

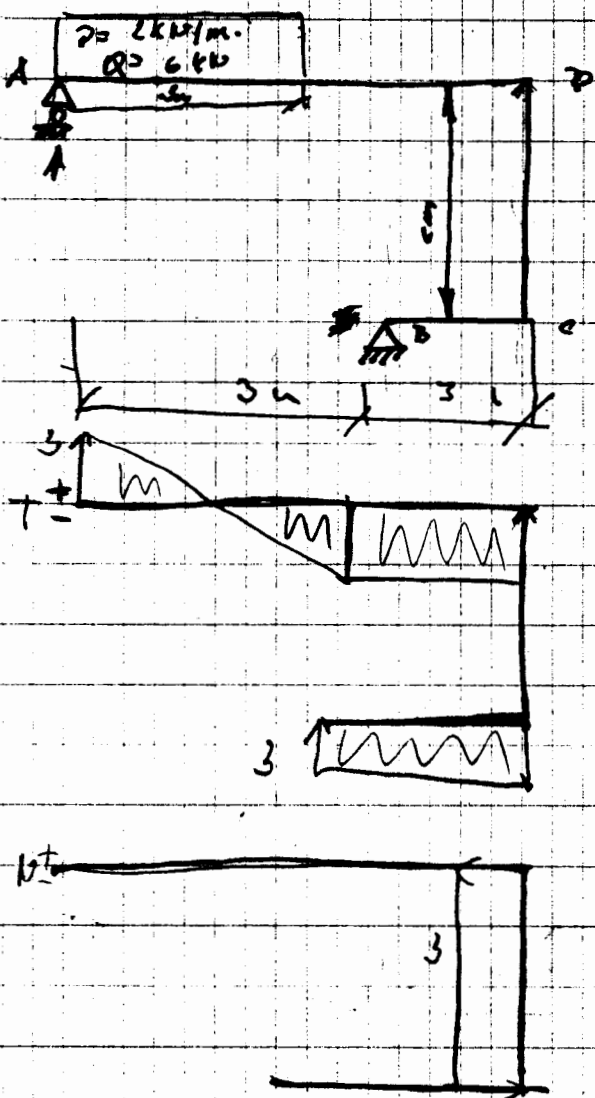
$AP = 800 \text{ kN}$

$\sum Y = 0 \Rightarrow AY = 2000$

$\sum X = 0 \Rightarrow AX = AY = 0$



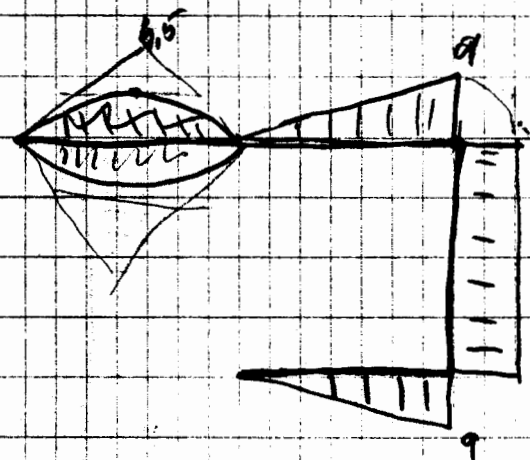
6.1.3



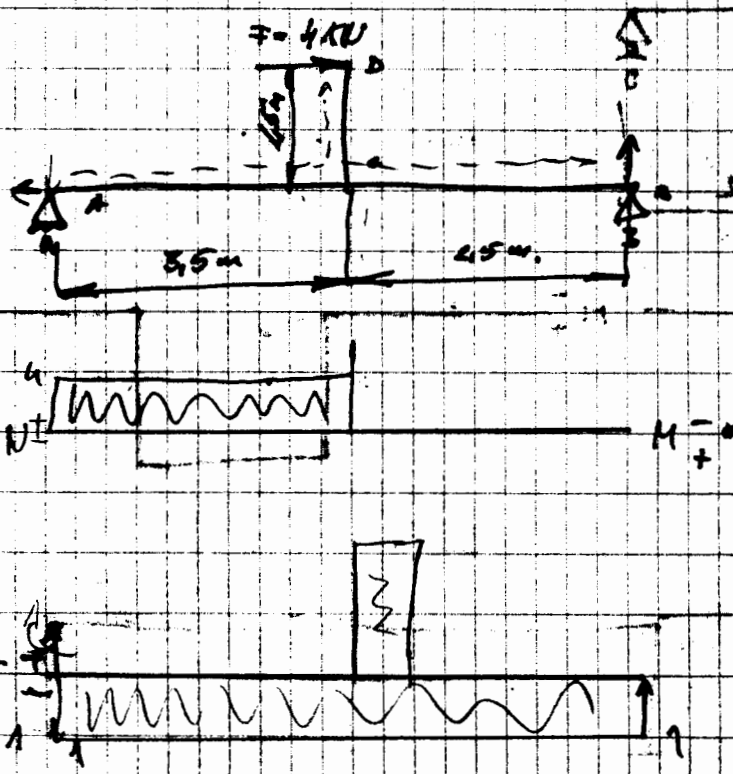
$\sum \mathcal{M}_B = 0 \Rightarrow +3 \cdot A_y - 1.5 \cdot 6 = 0$   
 $A_y = 3 \text{ kN}$

$\sum \mathcal{F}_y = 0 \Rightarrow A_y = 3 \text{ kN}$   
 $\sum \mathcal{F}_x = 0 \Rightarrow A_x = B_x = 0$

$\uparrow 36 \text{ G}$

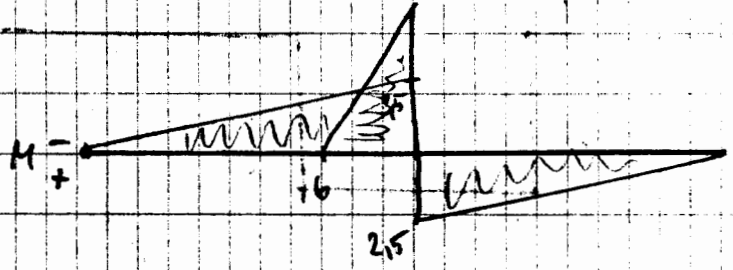


6.1.4



$\sum \mathcal{M}_B = 0 \Rightarrow +1.5 \cdot 4 - 6 \cdot 1.5 = 0$   
 $B = 1 \text{ kN}$

$\sum \mathcal{F}_y = 0 \Rightarrow A_y = 1 \text{ kN}$   
 $\sum \mathcal{F}_x = 0 \Rightarrow A_x = 4 \text{ kN}$



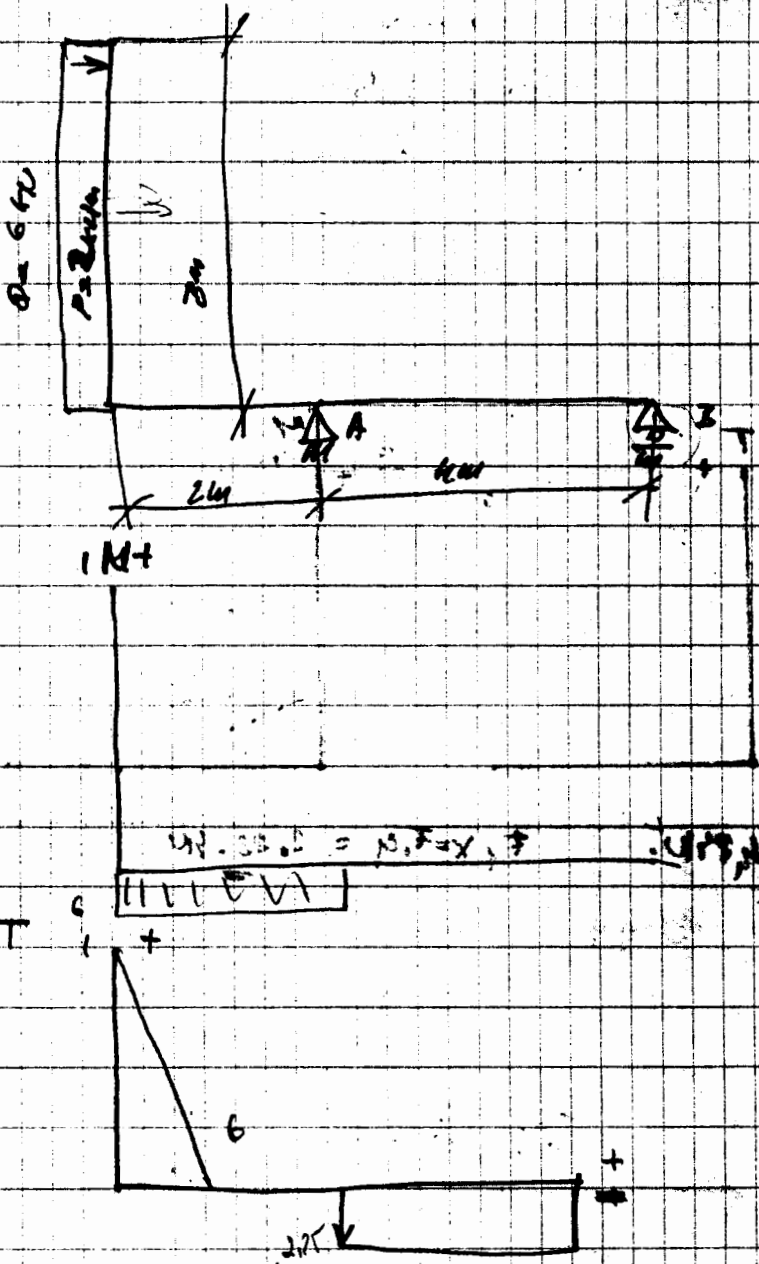
6.15

$$\sum \mathcal{M}_A = 0 \Rightarrow 1,5 \cdot 6 - 4 \cdot B_u = 0$$

$$\uparrow B_u = 2,25 \text{ KN}$$

$$\sum \mathcal{M} = 0 \Rightarrow \downarrow A_y = 2,25 \text{ KN}$$

$$\sum \mathcal{Y}_i = 0 \Rightarrow \leftarrow A_x = 6 \text{ KN}$$



6.16

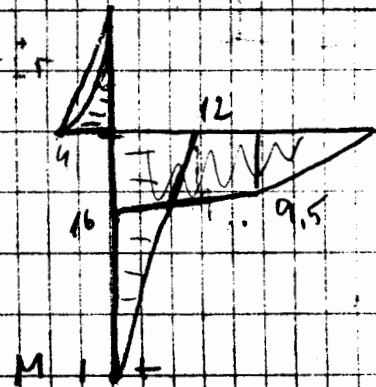
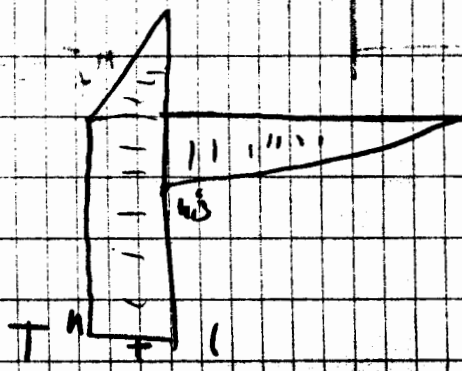
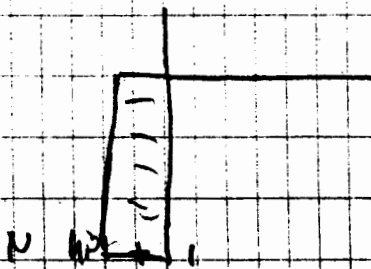
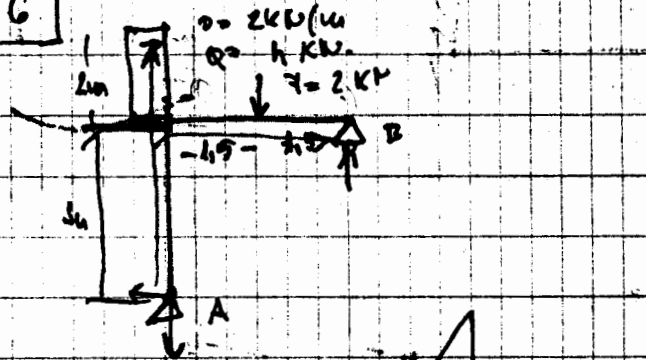
$$\sum \mathcal{M}_A = 0 \Rightarrow 4 \cdot 4 + 1,5 \cdot 2 - 0,3 \cdot B = 0$$

$$\uparrow B = 6,3 \text{ KN}$$

$$D_x = 0$$

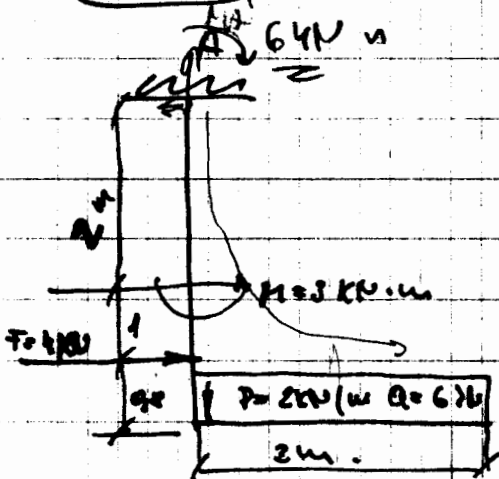
$$\sum \mathcal{Y}_i = 0 \Rightarrow \downarrow A_y = 4,5 \text{ KN}$$

$$\sum \mathcal{X}_i = 0 \Rightarrow \leftarrow A_x = 4 \text{ KN}$$





6.1.7.



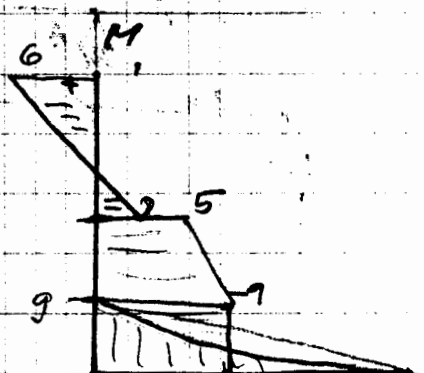
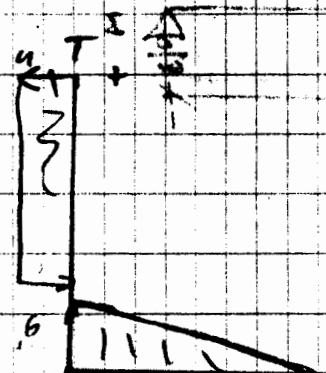
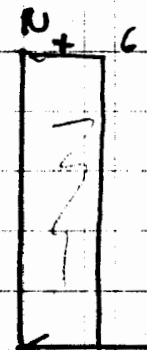
$$\sum M_A = 0 \Rightarrow -3 - 3 \cdot 4 + 1,5 \cdot 6 + MA = 0$$

$$MA = 6 \text{ kNm}$$

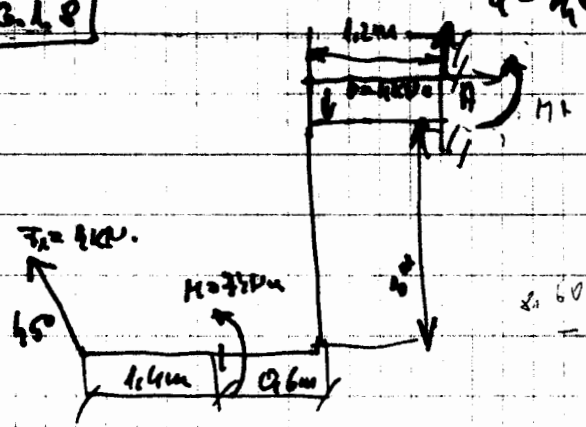
$$\sum Y_i = 0 \Rightarrow \uparrow AY = 6 \text{ kN}$$

$$\sum X_i = 0 \Rightarrow \leftarrow AX = 4 \text{ kN}$$

(0.1)



6.1.8



$$q = 4,8 \text{ kN/m}$$

$$F_{Y, X=1,4} = 2,2 \cdot 4 \text{ kN}$$

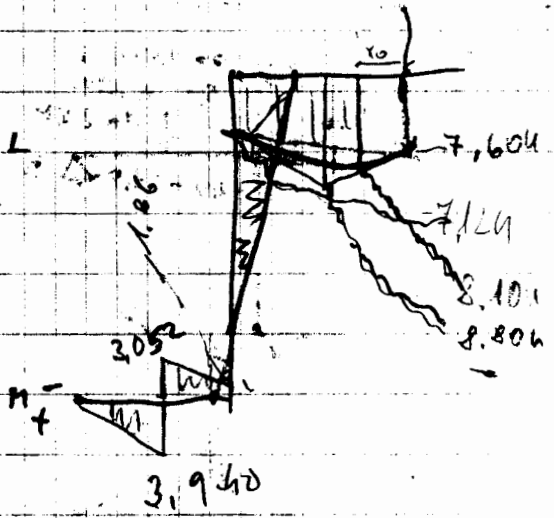
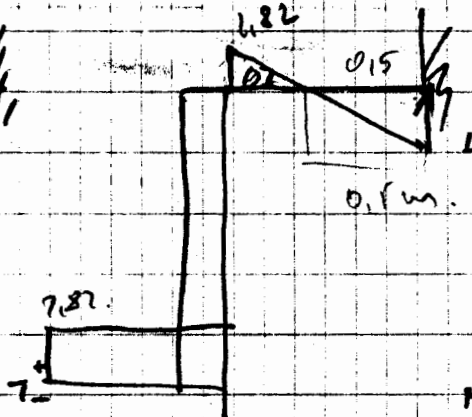
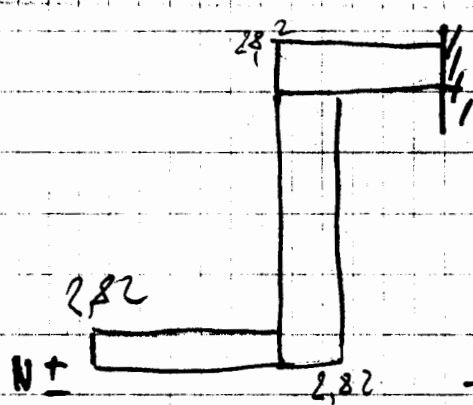
(12)

$$\sum M_A = 0 \Rightarrow +3 \cdot 1,4 \cdot 2 + 3,2 \cdot 2,82 - 7 - 0,6 \cdot 4,8 = MA = 0$$

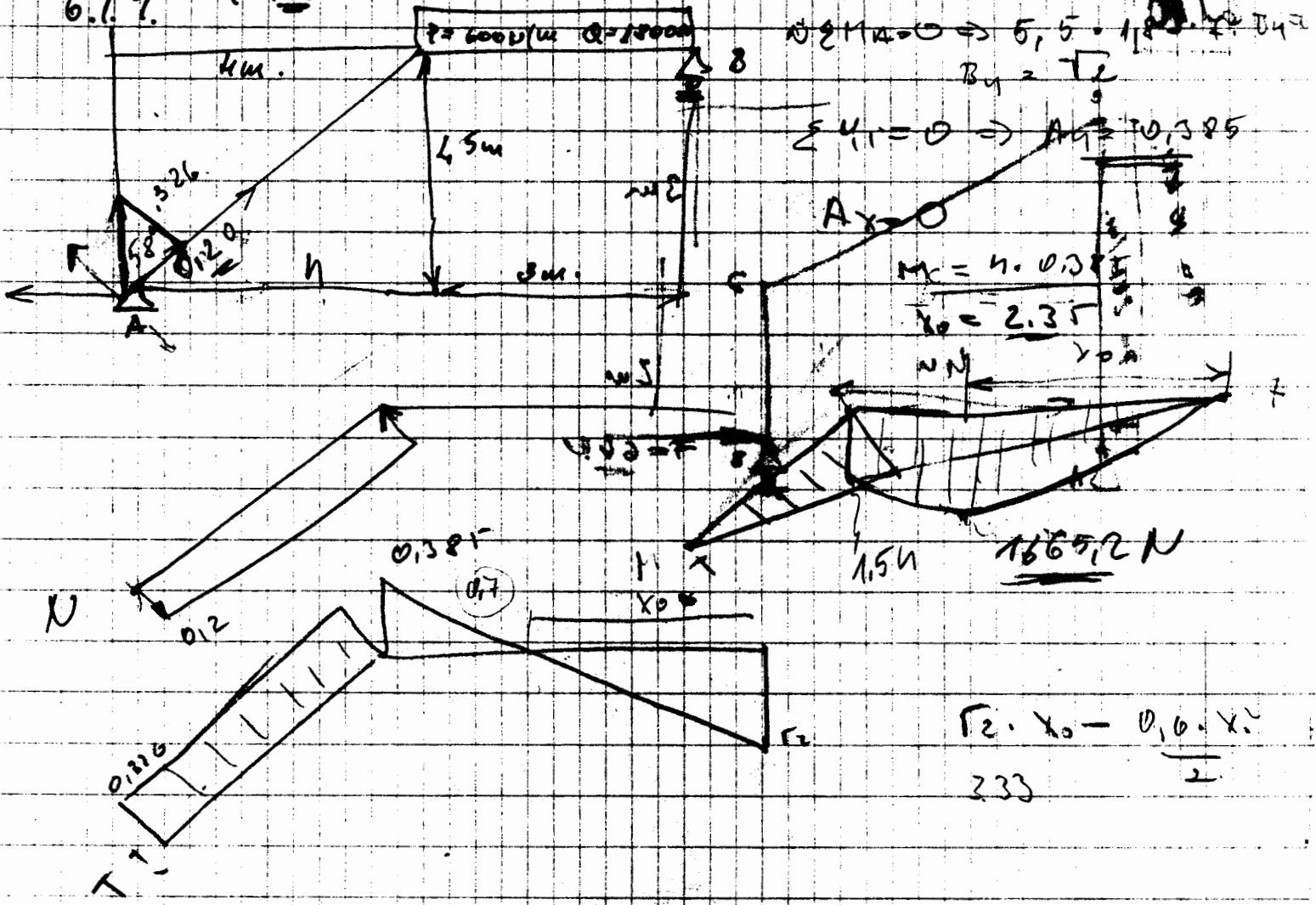
$$MA = 7,604 \text{ kNm}$$

$$\sum Y_i = 0 \Rightarrow AY = 2,4 \text{ kN} \uparrow$$

$$\sum X_i = 0 \Rightarrow AX = 2,8 \text{ kN} \rightarrow$$

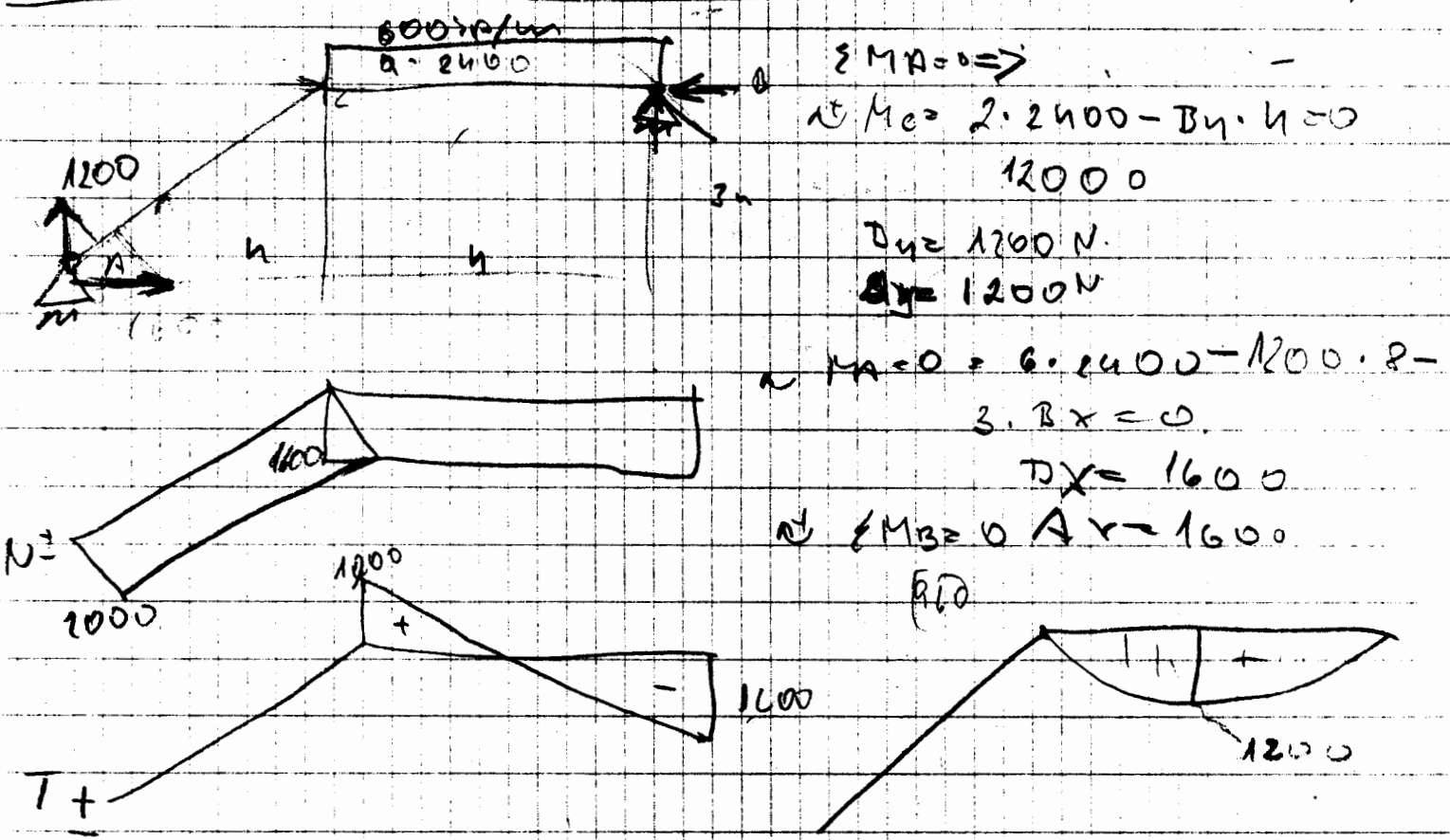


6.1.7.  $Q = 1.2 \text{ kN}$



$\sum M_A = 0 \Rightarrow 5.5 \cdot 1.2 \cdot 4 = B_y \cdot 4$   
 $B_y = 7.2$   
 $\sum H_i = 0 \Rightarrow A_x = 10.385$   
 $A_x = 0$   
 $M_x = 4 \cdot 0.385$   
 $x_0 = 2.35$   
 $y_0 = 1.5$

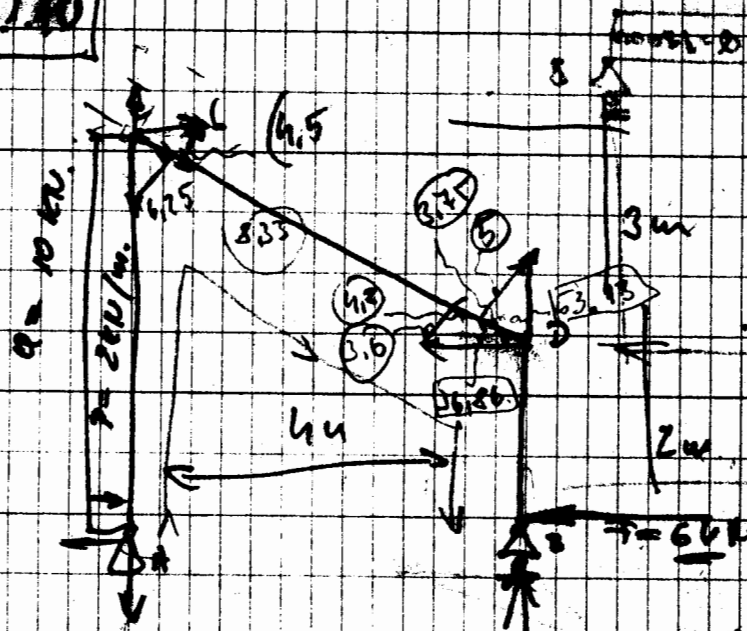
$\sqrt{2} \cdot x_0 = 0.6 \cdot x_0$   
 $233$



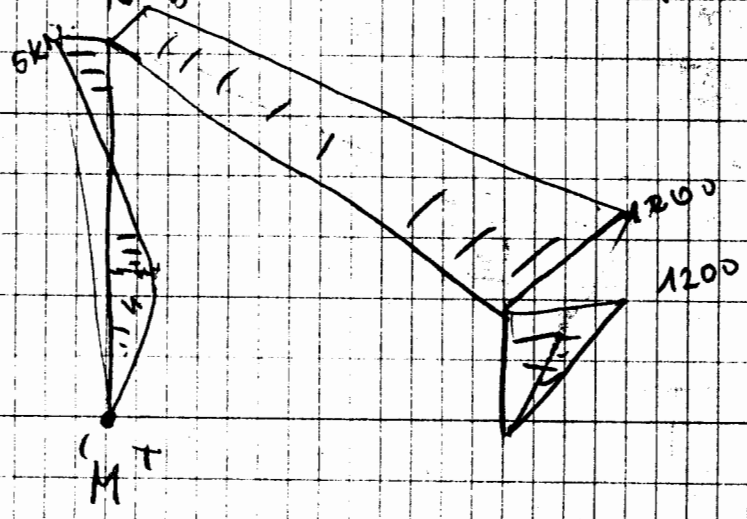
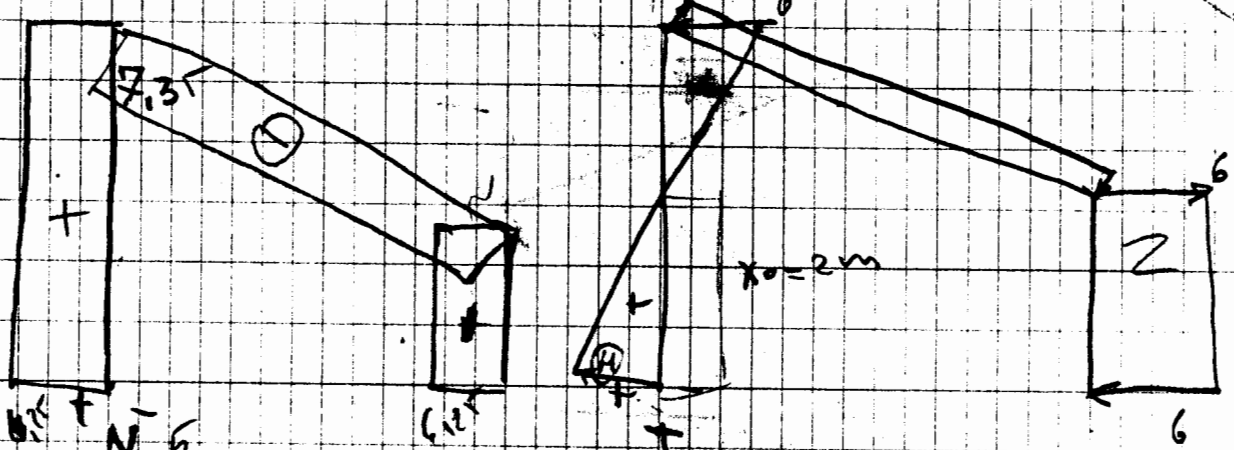
$\sum M_A = 0 \Rightarrow$   
 $15 M_0 = 2 \cdot 2400 - B_y \cdot 4 = 0$   
 $12000$   
 $B_y = 1200 \text{ N}$   
 $B_x = 1200 \text{ N}$

$\sum M_A = 0 = 6 \cdot 2400 - 1200 \cdot 2 - 3 \cdot B_x = 0$   
 $B_x = 1600$   
 $\sum M_B = 0 \Rightarrow A_x = 1600$

6.1.10

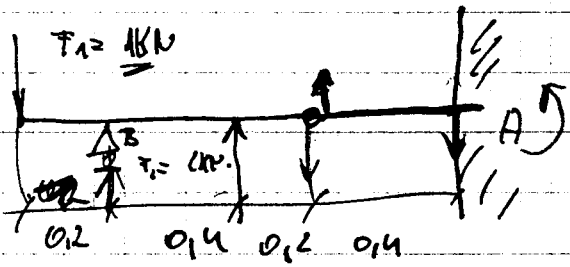


$\sum M_A = 0 \Rightarrow 2.5 \cdot 10 - B_y \cdot 4 = 0$   
 $B_y = 6.25 \text{ kN}$   
 $\sum Y_i = 0 \Rightarrow A_y = 6.25 \text{ kN}$   
 $\sum X_i = 0 \Rightarrow A_x = 6 \text{ kN}$   
 $\sum M_D = 0 \Rightarrow \dots$   
 $\frac{3}{4} = \frac{6.25}{x}$



+70

7.1



$$\sum M_C = 0 = -0.8 \cdot 1 + B \cdot 0.6 + 0.2 \cdot 2 = 0$$

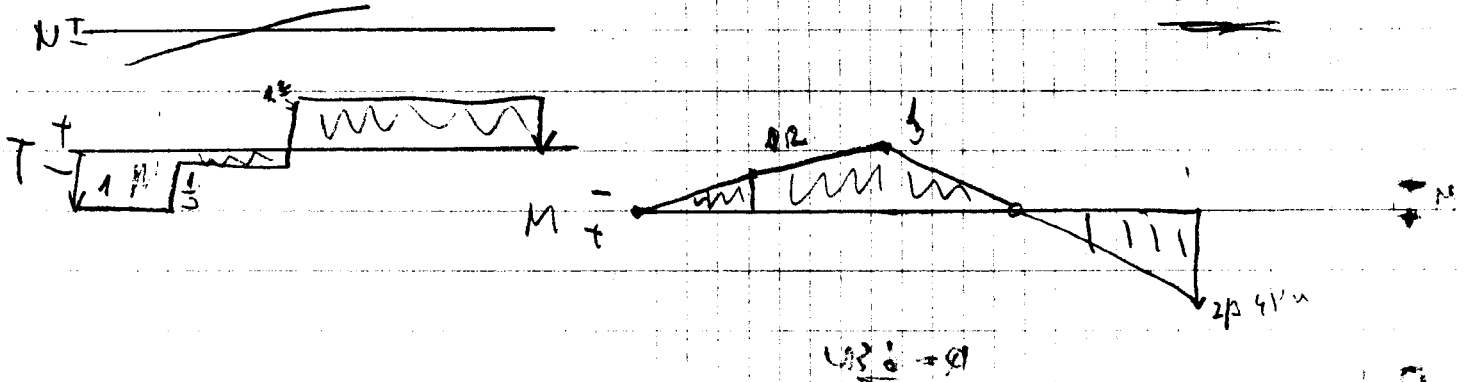
$$B = \frac{2}{2} = 1 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow C_y = 1.2 \text{ kN}$$

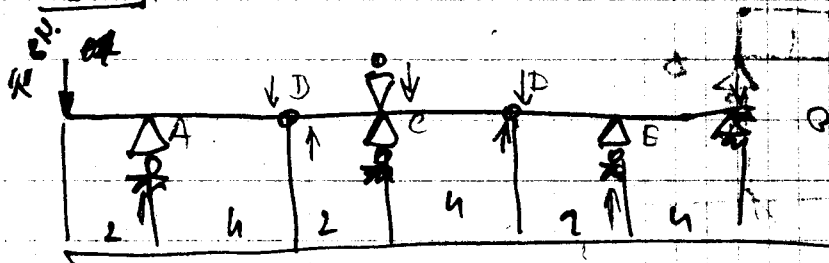
$$\downarrow A_y = 1.2$$

$$\sum M_A = 0 + 0.4 \cdot 1.2 - M_A = 0$$

$$M_A = \frac{2}{3} \text{ kNm}$$



7.1.2



$$\sum M_B = 0 \Rightarrow -2 \cdot 6 + 4 \cdot A_y = 0$$

$$A_y = 12 \text{ kN}$$

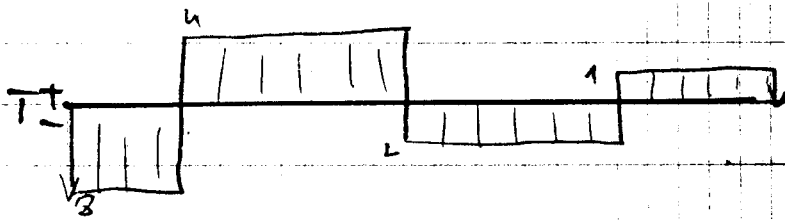
$$\sum Y_i = 0 \Rightarrow 5 \cdot 2 = 4 \cdot C_y$$

$$\sum M_D = 0 \Rightarrow 6 \cdot 4 - 4 \cdot C_y = 0$$

$$\downarrow C_y = 6 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow A_y = 2 \text{ kN}$$

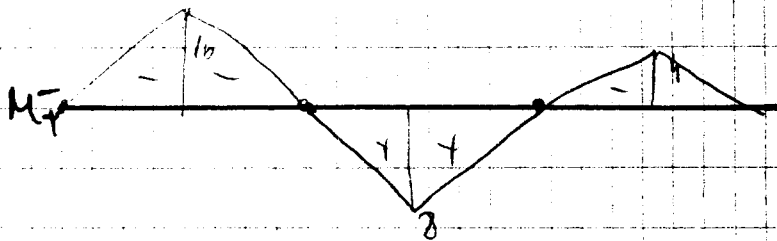
N = /



$$\sum M_C = 0 \Rightarrow -2 \cdot 6 + 4 \cdot E_y = 0$$

$$E_y = 3 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow 4 \cdot E_y = 1 \text{ kN}$$



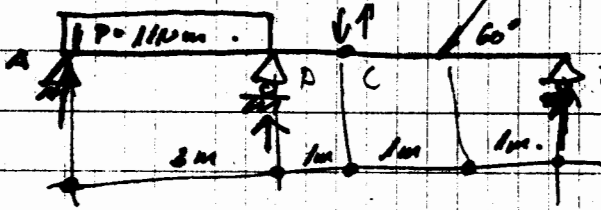
7.1.3

$Q = 34 \text{ kN}$

$F = 5 \text{ kNm}$

$F_{1x} = 1.54 \text{ kN}$

$F_{1y} = 2.597 \text{ kN}$



$\sum M_D = 0 \Rightarrow +2.59 - 2 \cdot D = 0$

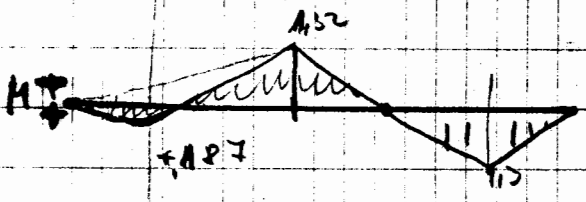
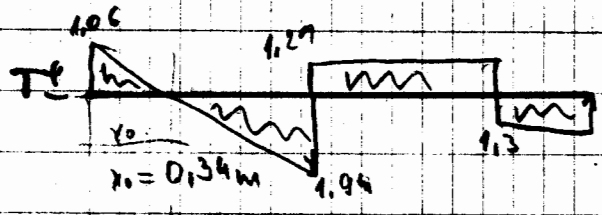
$D = 1.295 \text{ kN}$

$\sum Y_i = 0 \Rightarrow C_y = 1.3 \text{ kN}$

$\sum M_A = 0 \Rightarrow +1.5 \cdot 3 - 3 \cdot D_y + 4 \cdot 1.3 = 0$

$D_y = 3.23$

$\sum U_i = 0 \Rightarrow A_y = 1.06$

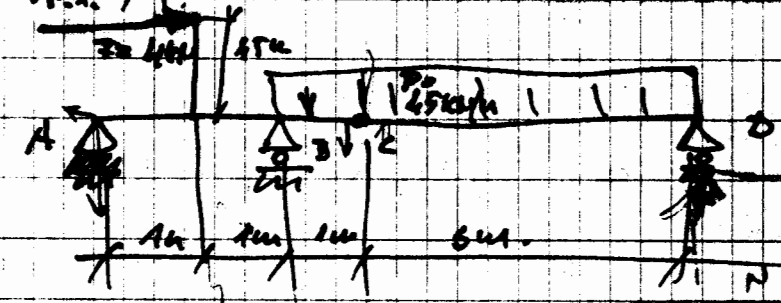


7.1.4

$Q = 6 \text{ kN}$

$\sum M_C = 0 \Rightarrow 1.5 \cdot 4.5 - 3 \cdot D_y = 0$

$D_y = 2.25 \text{ kN}$



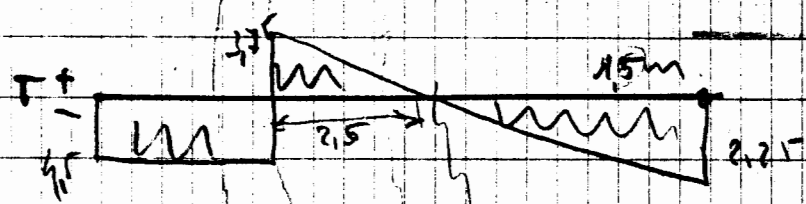
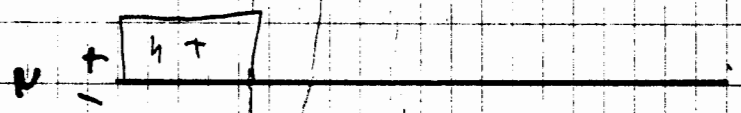
$\sum Y_i = 0 \Rightarrow C_y = 2.9 \text{ kN}$

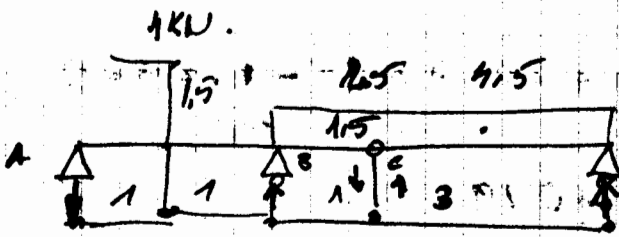
$\sum M_A = 0 \Rightarrow 1.5 \cdot 4 + 2.5 \cdot 1.5 - 2 \cdot D_y - 3 \cdot 2.25 = 0$

$D_y = 4.75 \text{ kN}$

$\sum Y_i = 0 \Rightarrow A_y = 4.5$

$\sum X_i = 0 \Rightarrow A_x = 4.5$





$$\sum M_A = 0 = 1.5 \cdot 4.5 - D \cdot 3$$

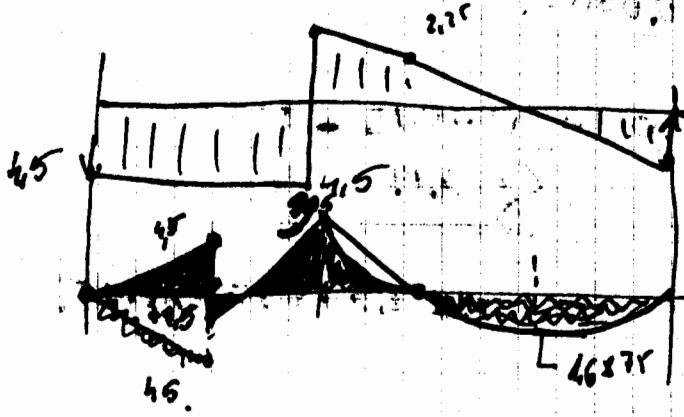
$$\uparrow D = 2.25$$

$$\sum F_y = 0 = 1 - 4.5 + 2.25 + C_4 = 0$$

$$C_4 = 2.25$$

$$\sum M_B = 0 = 4 \cdot 4.5 - 3 \cdot 2 + 4.5 \cdot 2.5 + 3 \cdot 2.25$$

$$B_y = 8.25 \text{ kN}$$



$$\sum F_y = 0 = 8.25 - 1.5 - 2.25 + A_2 = 0$$

$$A_2 = 4.5$$

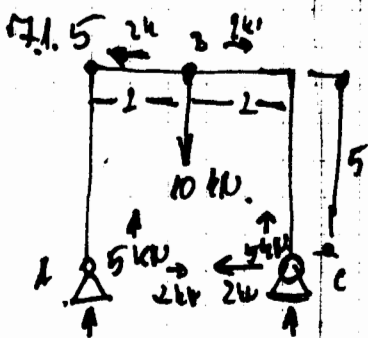
$$-2 \cdot 4.5 + 6$$

$$9 - 6$$

$$16.875 = \frac{p \cdot x^2}{2} = \frac{4.5 \cdot 0.5^2}{2}$$

$$16.875 = 4.5 \cdot 4.5^2$$

$$- [16 \cdot 2.25] + 1.5 \cdot 1.5 \cdot 0.75$$



$$\sum M_B = -2 \cdot 5 + 5 \cdot C_x = 0$$

$$C_x = 2$$

→ 2 kN  
← 2 kN

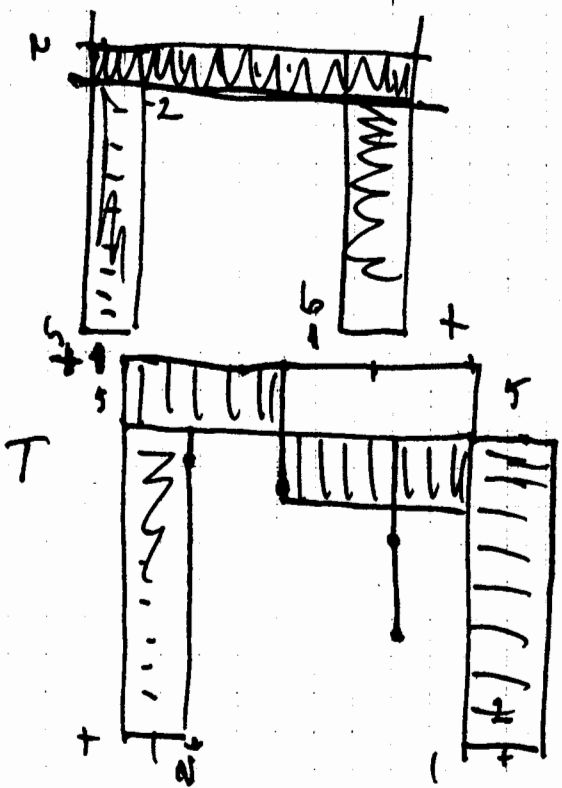
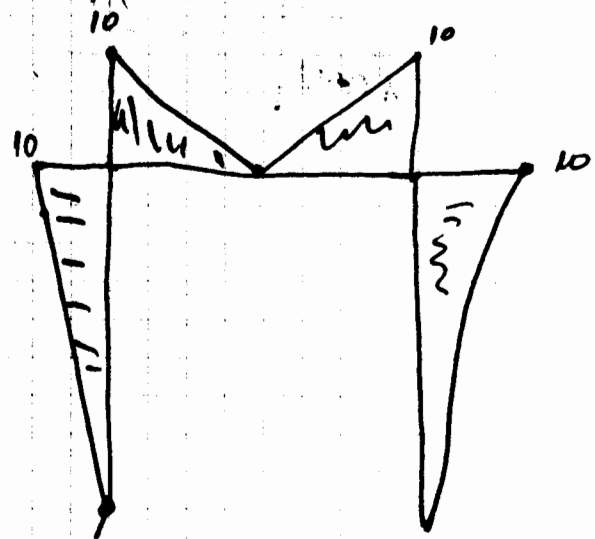
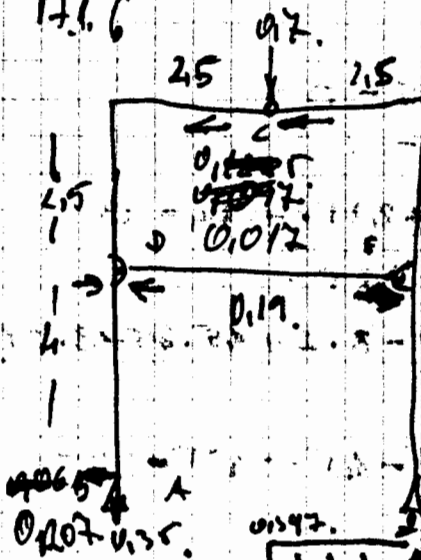


Fig. 6

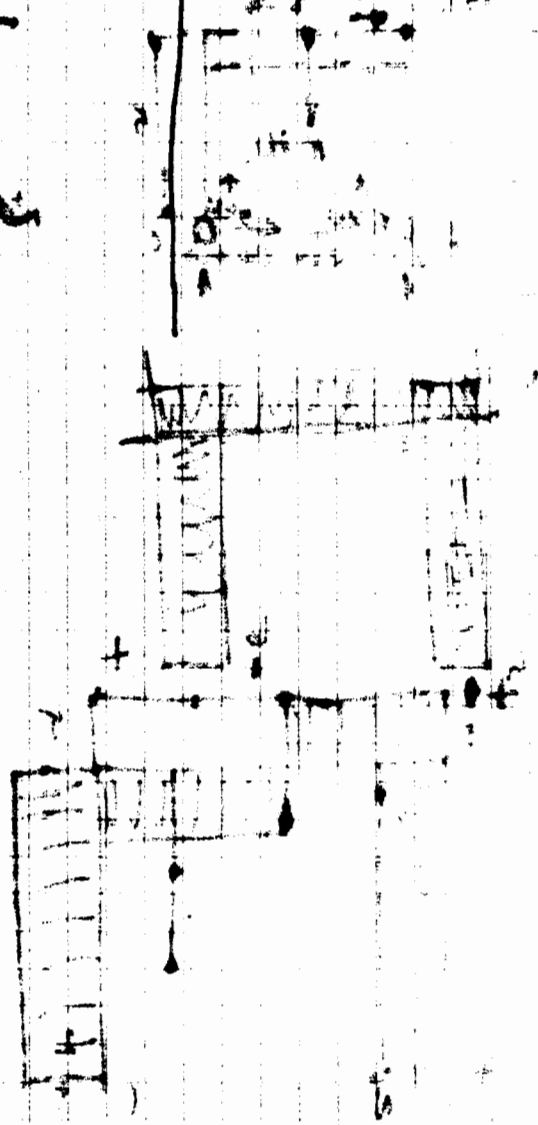
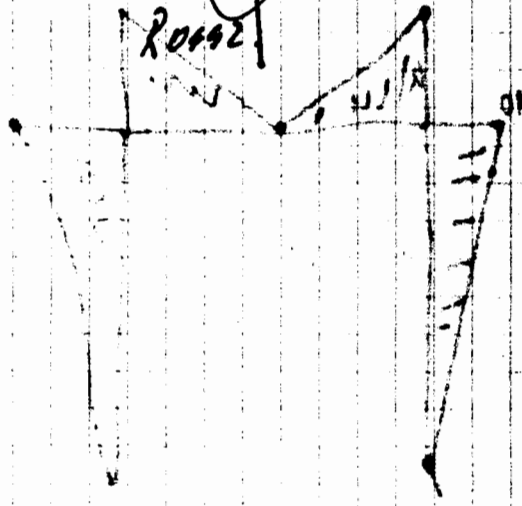
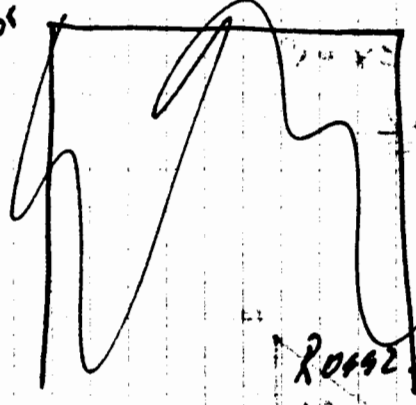
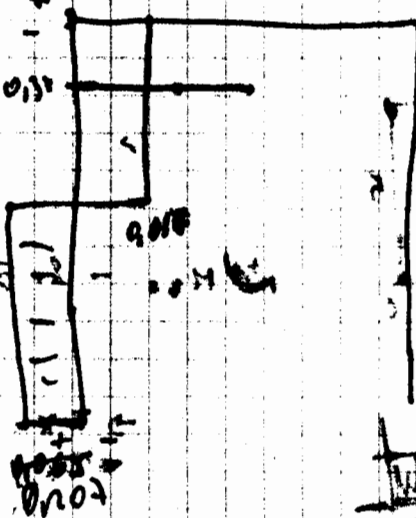
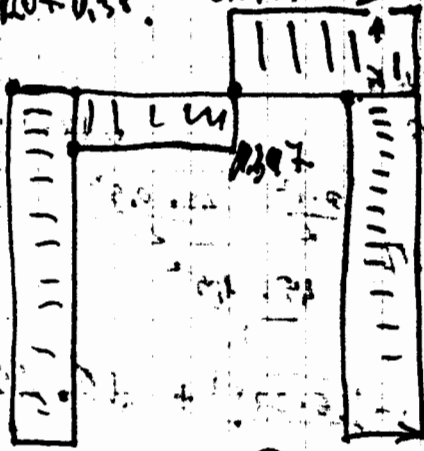


$$\sum M_{C0} = 0 \Rightarrow 2 \cdot 0.2 + x \cdot 2.5 - 0.215 = 0$$

$$\sum M_C = 0 \Rightarrow 2.5 \cdot 0.19 - 0.15 \cdot 2.5 + F_{AY} \cdot 0.5 = 0$$

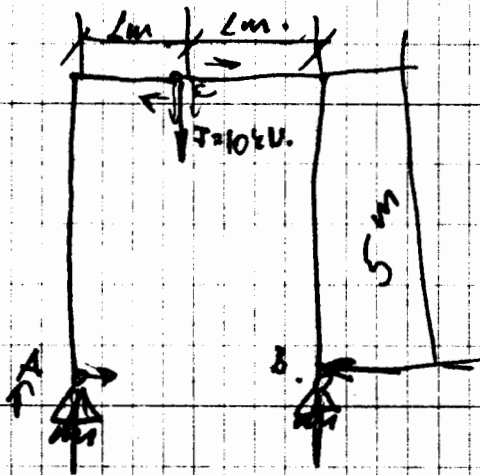
$$\sum M_{A0} = 0 \Rightarrow 2 \cdot 0.1 + 0.12 + 0.19 = Cx = 0$$

$$C = \frac{0.41}{0.79}$$





7.1.5



$$\sum M_A = 0 \Rightarrow 2 \cdot 10 - 4 \cdot B_y = 0$$

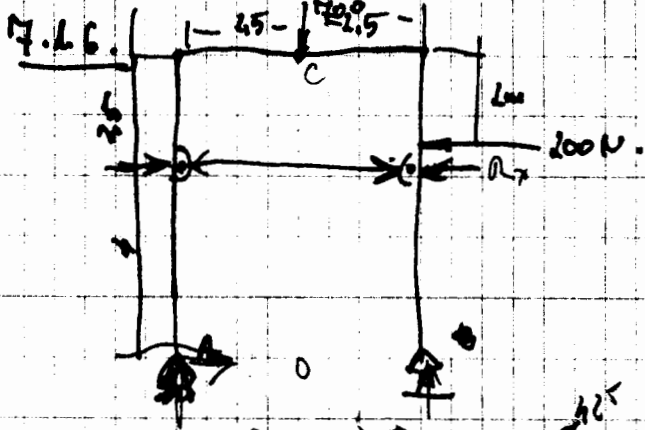
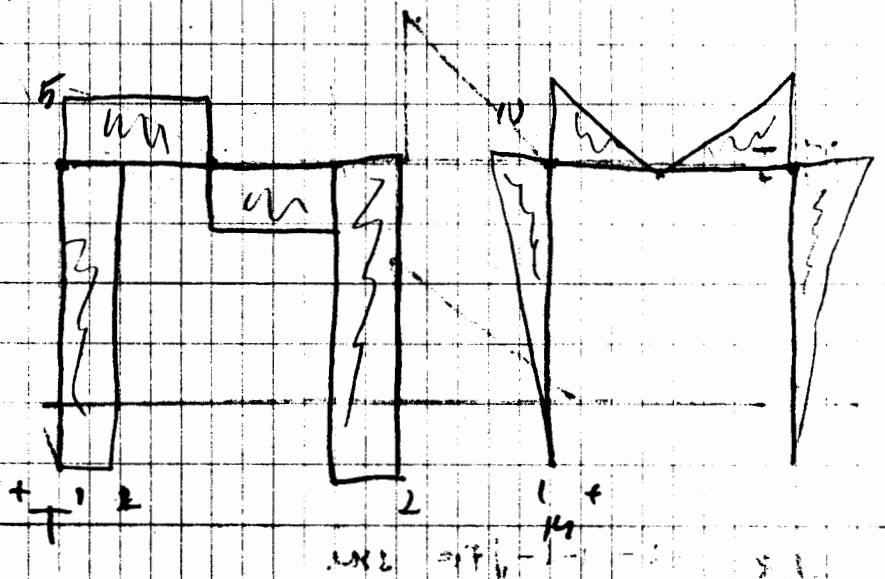
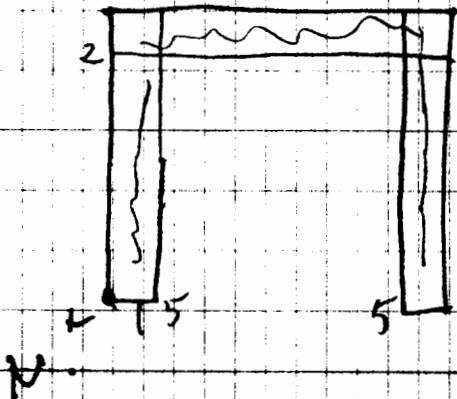
$$B_y = 5$$

$$\sum Y_i = 0 \Rightarrow A_y = 5 \text{ kN}$$

$$\sum M_C = 0 \Rightarrow 2 \cdot 5 - 5 \cdot A_x = 0$$

$$A_x = 2 \text{ kN}$$

$$C_x = 2 \text{ kN}$$



$$\sum M_A = 0 \Rightarrow 2.5 \cdot 1700 - 2.5 \cdot 200 - 5 \cdot B_y = 0$$

$$B_y = 170 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow A_y = 530 \text{ kN}$$

$$\sum M_C = 0 \Rightarrow 2 \cdot 200 - 2.5 \cdot 170 + 2.5 \cdot A_x = 0$$

$$A_x = 101 \text{ N}$$

$$\sum Y_i = 0 \Rightarrow C_y = 170 \text{ kN}$$

$$\sum X_i = 0 \Rightarrow C_x = 210$$

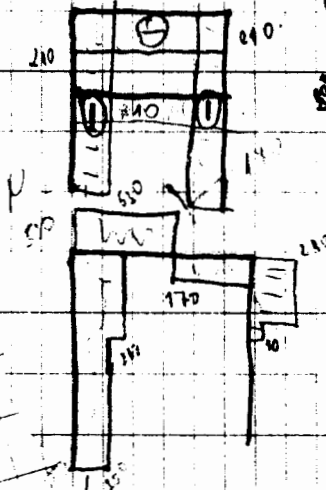
$$\sum M_C = 0 \Rightarrow -2.5 \cdot 10 + 2.5 \cdot 530$$

$$- A_x \cdot 6.5 = 0$$

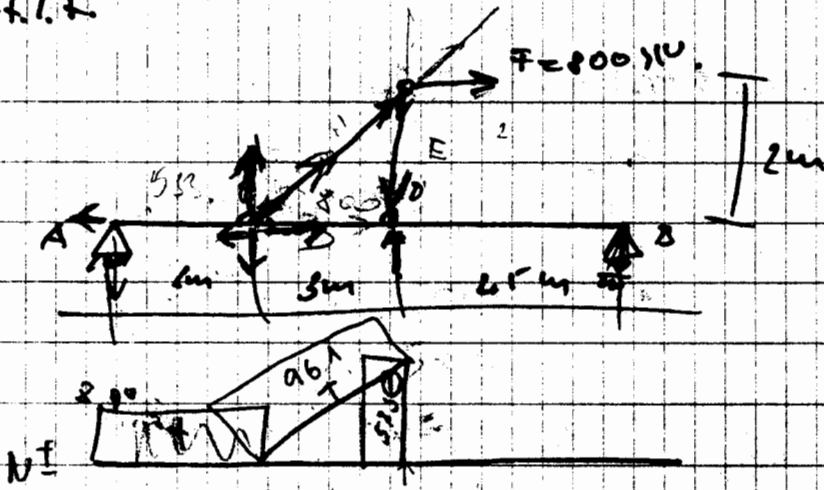
$$A_x = 200$$

$$\sum Y_i = 0 \Rightarrow C_y = 530$$

$$\sum X_i = 0 \Rightarrow C_x = 210$$

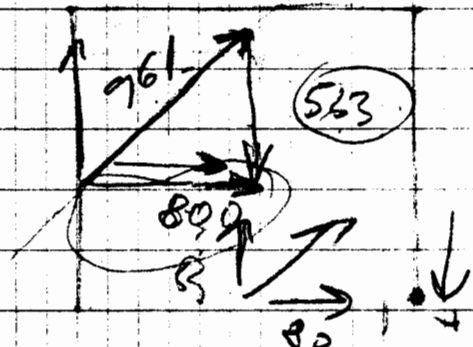
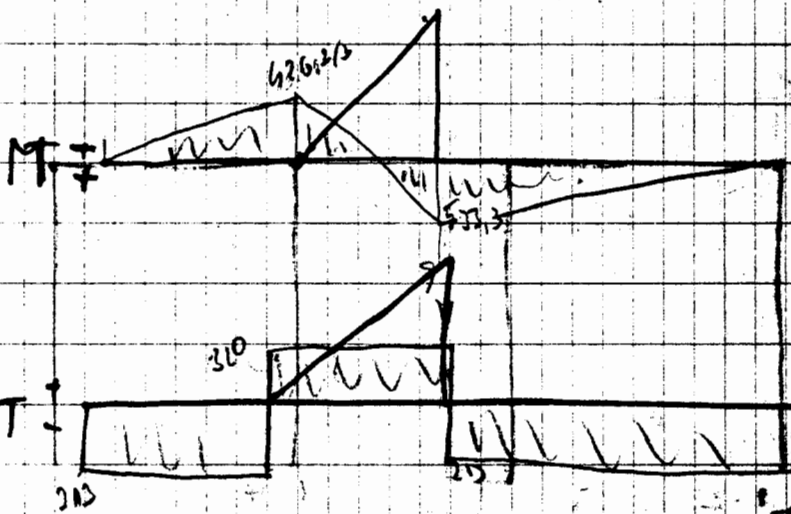


7.1.7

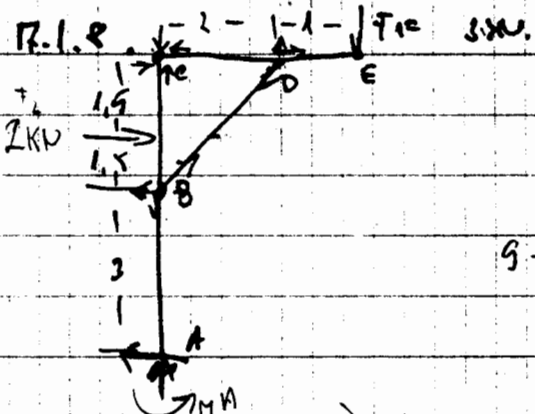


$\sum M_A = 0 \Rightarrow 2 \cdot 800 = 2 \cdot 3 \cdot D_y$

$\sum Y_i = 0 \Rightarrow D_y = 266.67 \text{ N}$   
 $\sum X_i = 0 \Rightarrow A_x = 800 \text{ N}$   
 $\frac{2}{3} = \frac{D_y}{4.5} \Rightarrow D_y = 533.33 \text{ N}$   
 $A_x = 800 \text{ N}$   
 $C_y = 711.11 \text{ N}$   
 $C_x = 800 \text{ N}$



7.1.8

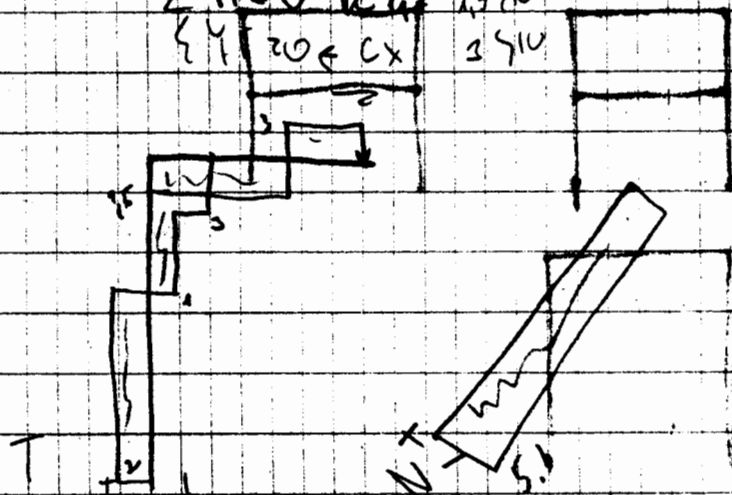
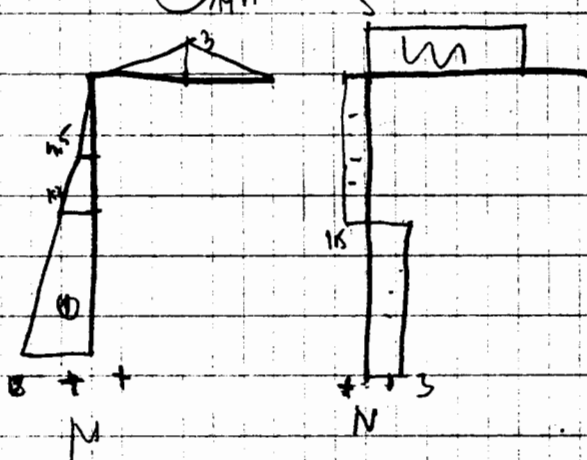


$\sum M_A = 0 \Rightarrow 4.5 \cdot 2 + 3 \cdot 3 - M_A = 0$

$M_A = 18 \text{ kNm}$   
 $\sum Y_i = 0 \Rightarrow D_y = 3 \text{ kN}$   
 $\sum X_i = 0 \Rightarrow C_x = 2 \text{ kN}$   
 $\sum M_C = 0 \Rightarrow 3 \cdot 3 - D_y \cdot 2 = 0$   
 $D_y = 4.5 \text{ kN}$

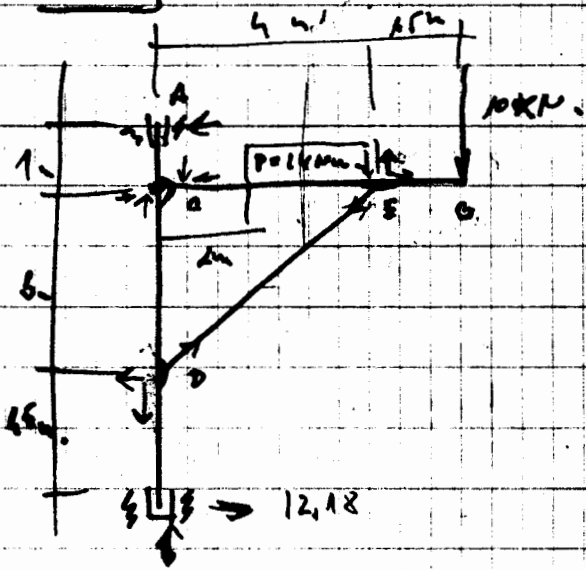
$\frac{2}{3} = \frac{D_y}{4.5} \Rightarrow D_y = 3 \text{ kN}$

$\sum Y_i = 0 \Rightarrow C_y = 1.5 \text{ kN}$   
 $\sum X_i = 0 \Rightarrow C_x = 2 \text{ kN}$



17.17

$Q = 4 \text{ kN}$



$$\sum M_A = 0 \Rightarrow 3 \cdot 4 + 5.5 \cdot 10 - 5.5 \cdot C_y = 0$$

$$3 \cdot 4 = 17.18 \cdot 4 \Rightarrow C_y = 17.18 \text{ kN}$$

$$\sum X = 0 \Rightarrow A_x = 17.18 \text{ kN} \rightarrow$$

$$\sum Y = 0 \Rightarrow B_y = 14 \text{ kN} \uparrow$$

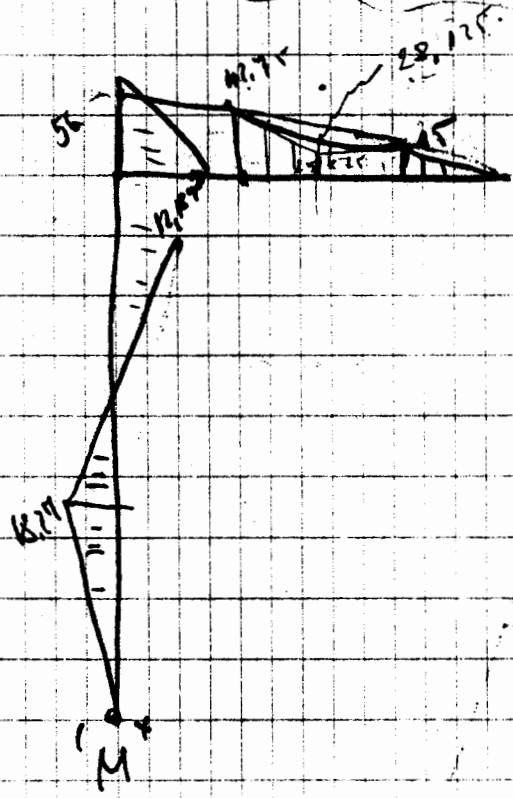
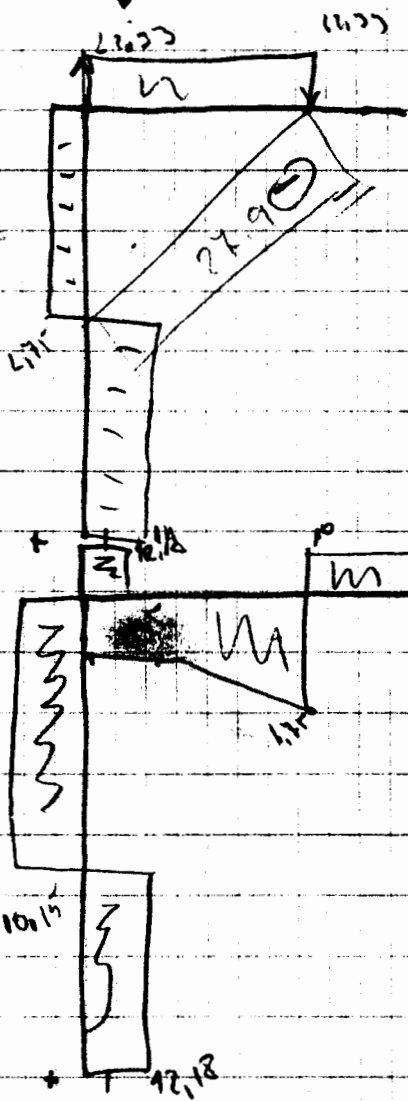
$$\sum M_B = 0 \Rightarrow 3 \cdot 4 - 4 \cdot E_y + 10 \cdot 9.5 = 0$$

$$E_y = 16.75 \text{ kN}$$

$$\sum H = 0 \Rightarrow C_x = 2.75$$

$$\frac{3}{4} = \frac{16.75}{E_x} \Rightarrow E_x = 22.33$$

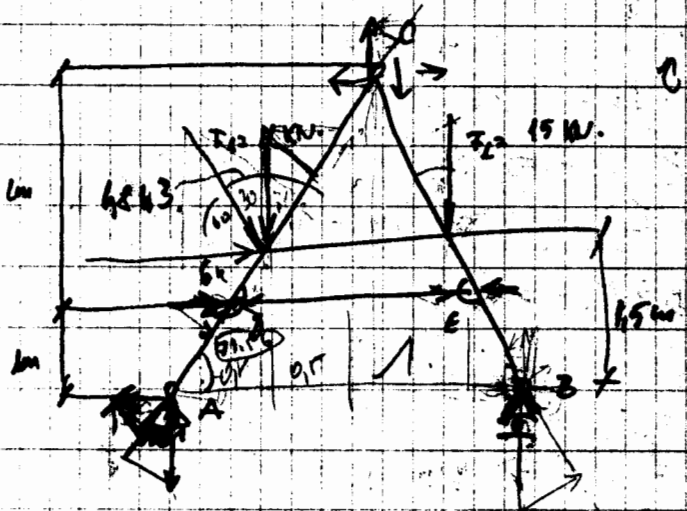
$$\sum X = 0 \Rightarrow C_x = 22.33$$



T

7.1.10

$F_1 x = 6 \text{ kN}$   
 $F_1 y = 10,57 \text{ kN}$



$\sum M_A = 0 \Rightarrow 10,57 \cdot 1,5 - 1,5 \cdot 1,5 - 2 \cdot 1,5 = 0$

$\sum Y = 0 \Rightarrow Ay = 7,057 \text{ kN}$

$\sum X = 0 \Rightarrow Ax = 6,91 \text{ kN}$

$\sum M_C = 0 \Rightarrow 0,5 \cdot 1,5 = 1 \cdot 10,57 + 2 \cdot 1,5$   
 $\Rightarrow Bx = 5,42 \text{ kN}$

$F_1 x = 6,91$

$\sum X \Rightarrow Cx = 5,42$

$F_1 y = 10,57$

$\sum Y \Rightarrow Cy = 3,34$

$Ax = 5,69$

$F_2 x = 4,74$

$Ay = 1,89$

$Bx = 5,79$

$Ax = 2,23$

$Bx = 1,39$

$Ay = 6,68$

$Cy = 5,14$

$Cy = 1,056$

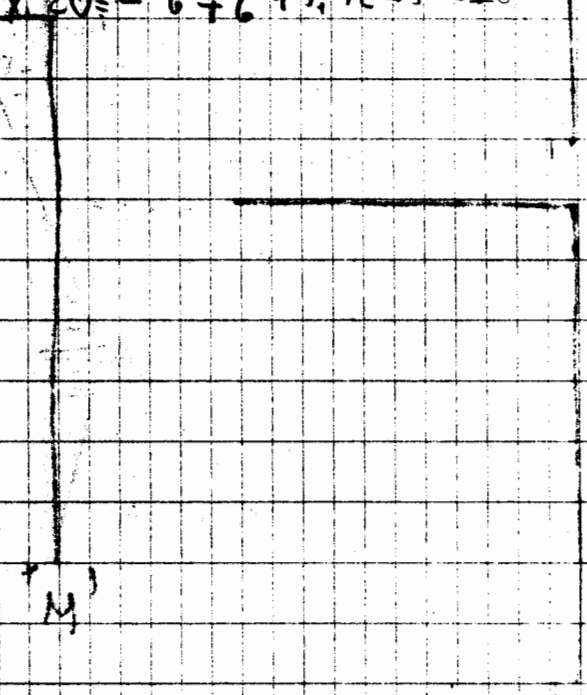
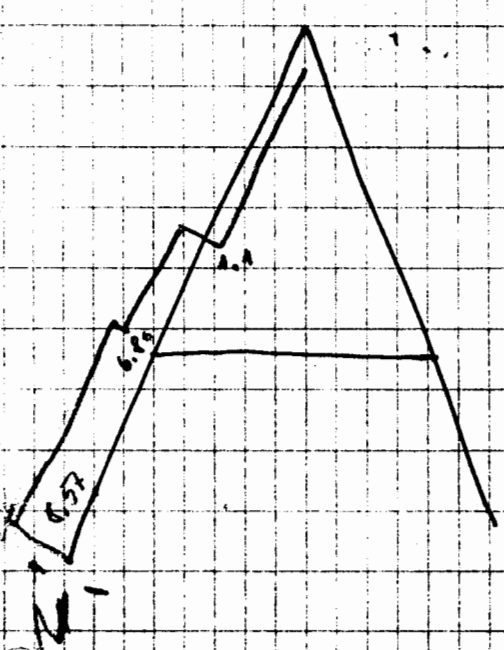
$Cx = 1,11$

$Cx = 3,16$

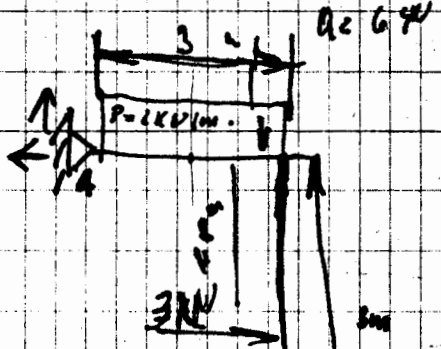
$\sum M_C = 0 \Rightarrow 0,5 \cdot 10,57 - 1,5 \cdot 6 - 2 \cdot 5,42 + 1 \cdot 7,05 + 3 \cdot 6 = 0$

$\sum Y = 0 \Rightarrow 7,05 + 10,57 + 3,34 = 0$

$\sum X = 0 \Rightarrow -6 + 6 + 5,42 - 5,42 = 0$



A.1.11.



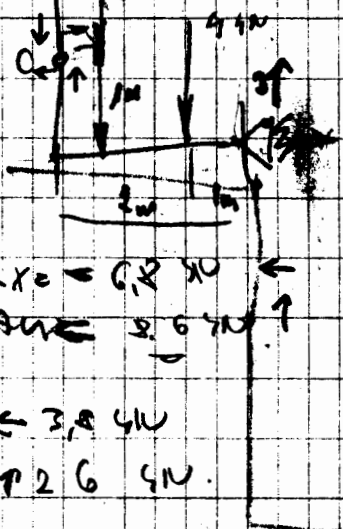
$$\sum M_A = 0 = 1,5 \cdot 6 - 1,5 \cdot 3 - 3 \cdot B_x - 6 \cdot B_y + 21 \cdot 1,5 = 0$$

$$23,6 - 3B_x - 6B_y = 0$$

$$\sum M_C = 0 \Rightarrow 2 \cdot 4 + 3 \cdot D_y + 1 \cdot D_x = 0$$

$$8 - 3D_y + 1D_x = 0$$

$$B_x = -3B_y + 2$$



$$23,6 = 4(-3B_y + 2) - 6B_y = 0$$

$$23,6 + 12B_y - 32 = 6B_y = 0$$

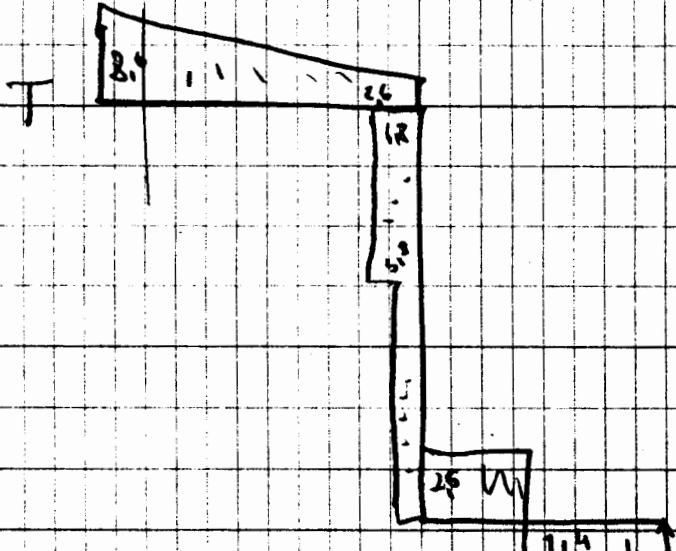
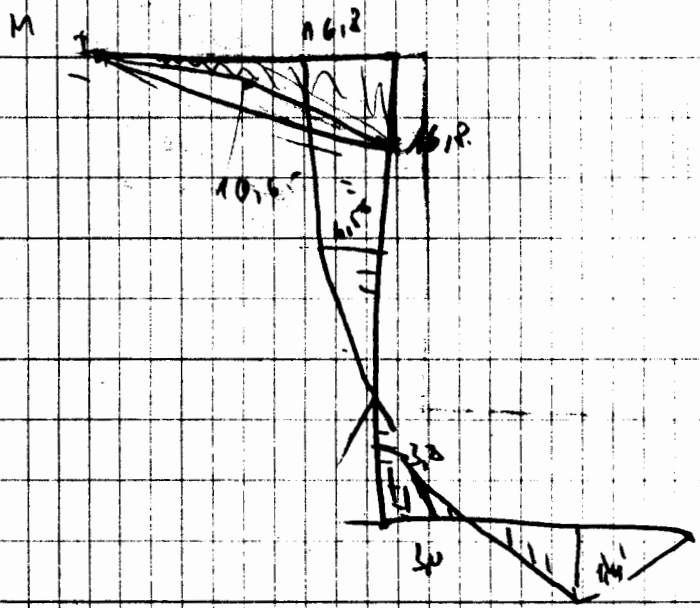
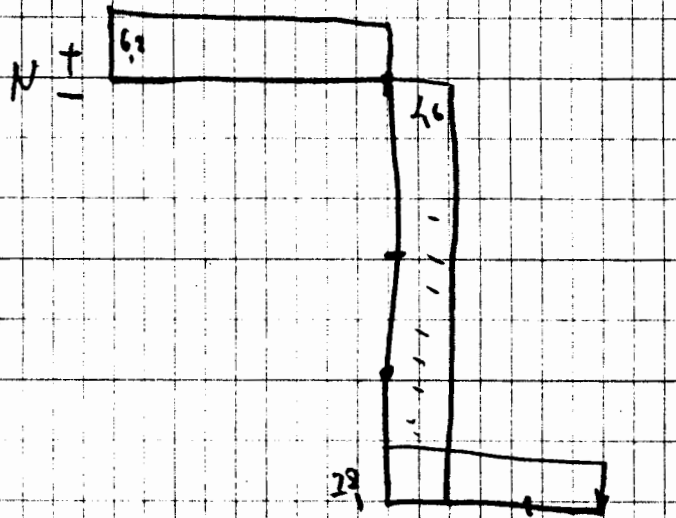
$$-8,4 = -6B_y$$

$$B_y = 1,4 \text{ kN}$$

$$23,6 = -4D_y - 6 \cdot 1,4 = 0$$

$$D_x = 3,8 \text{ kN}$$

$\sum X_i = 0 \Rightarrow A_x = 3,8 \text{ kN} \leftarrow$   
 $\sum Y_i = 0 \Rightarrow A_y = 2,6 \text{ kN} \uparrow$   
 Solb:  $C_x = 3,8 \text{ kN} \leftarrow$   
 $C_y = 2,6 \text{ kN} \uparrow$



17.1.12.

$Q = 4 \text{ KN}$

total  $M_B \Rightarrow 4.5 \cdot 3 + 1.4 \cdot 2 + 2 \cdot 4 + 1.6 \cdot 2 = 27.8 \text{ KNm}$   
 $M_D = 0.77 \text{ KNm}$

$C + \sum M_C = 0 \Rightarrow -4.5 + 3 \cdot A_H = 0 \Rightarrow A_H = 1.5 \text{ KN}$

$A_H = 1.5 \text{ KN}$

$\sum X_i = 0 \Rightarrow C_H = 0$

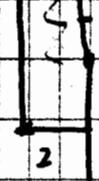
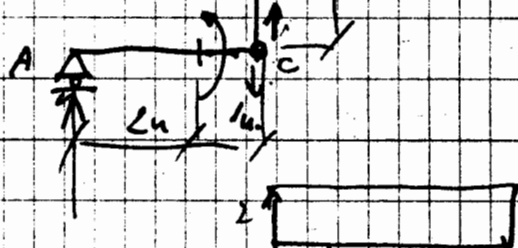
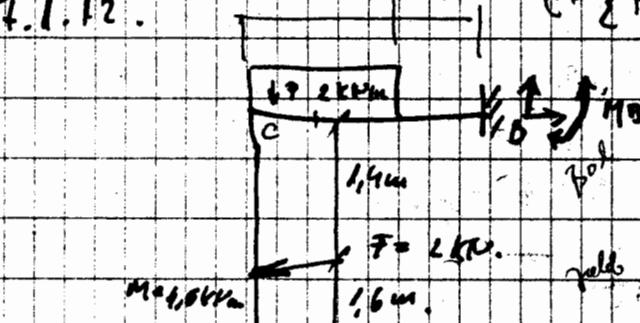
$\sum Y_i = 0 \Rightarrow C_V = 1.5 \text{ KN}$

$\sum Y_i \Rightarrow B_H = 2.5 \text{ KN}$

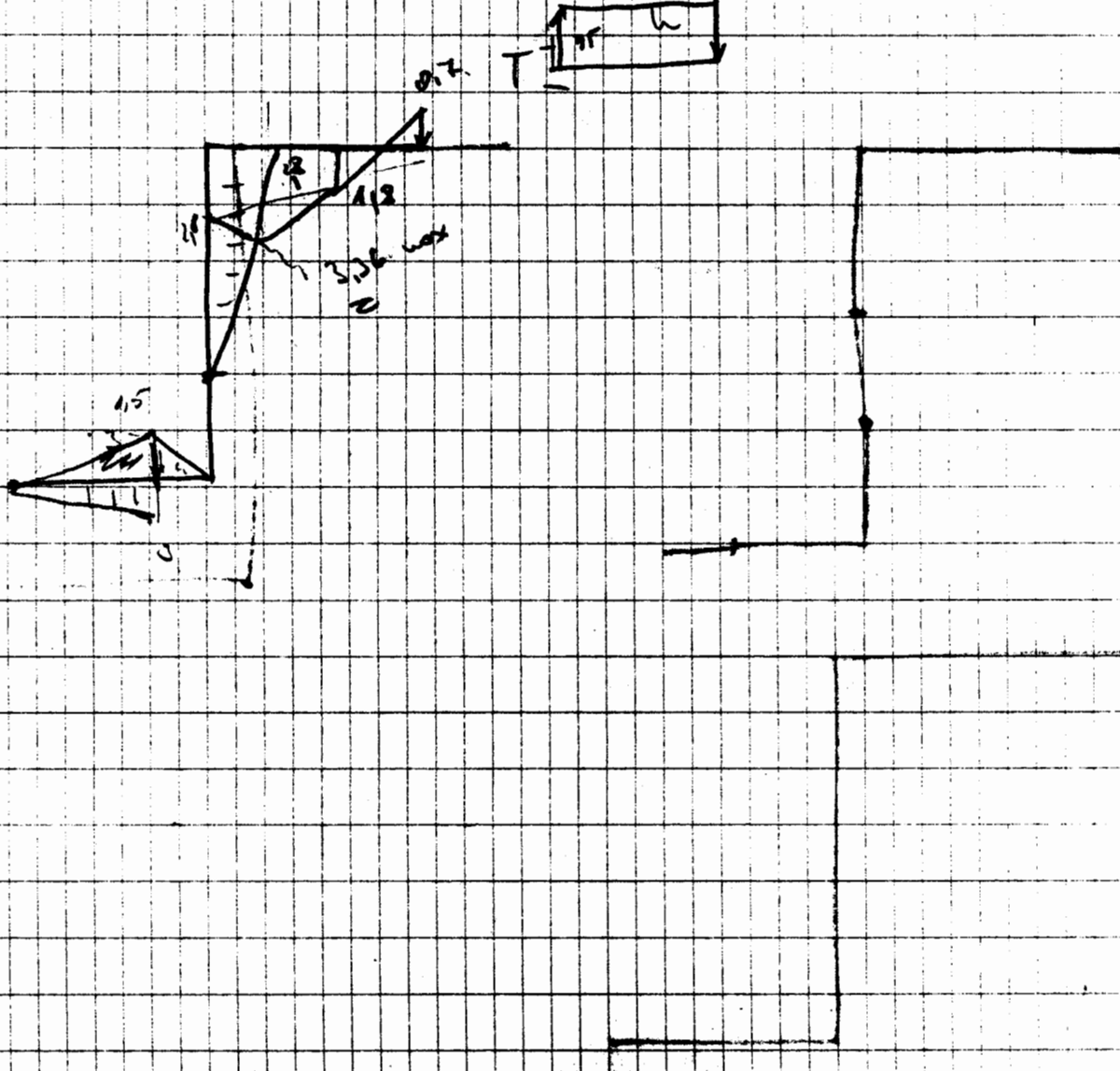
$C + \sum M_C = 0 \Rightarrow -1.6 \cdot 2 + 1 \cdot 4 - 3 \cdot 2.5 +$

$+ 3 \cdot D_V = 0$

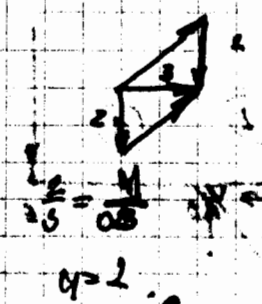
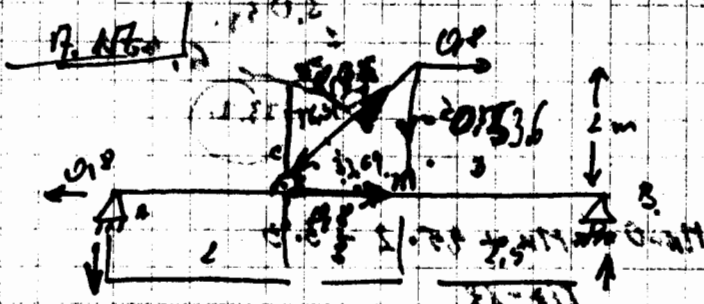
$D_V = 2.0 \text{ KN}$



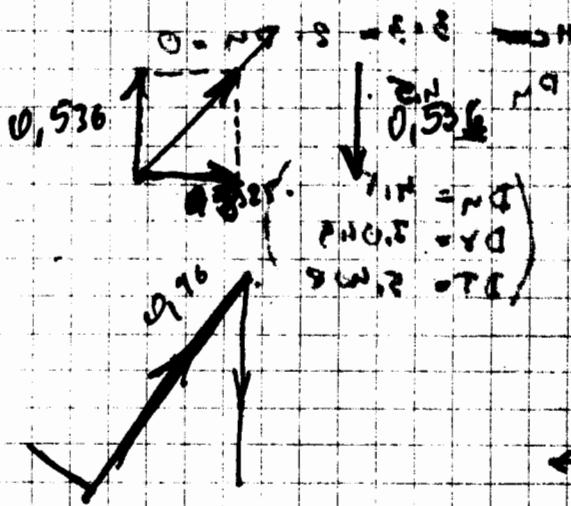
$M \pm$







33, 69



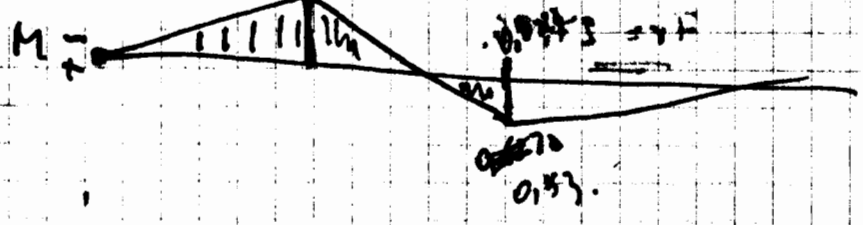
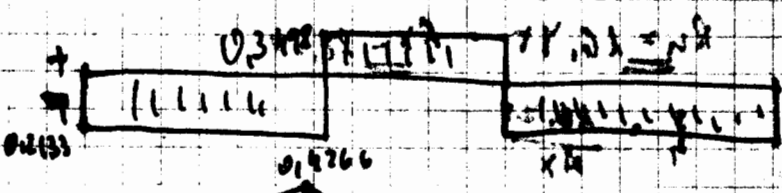
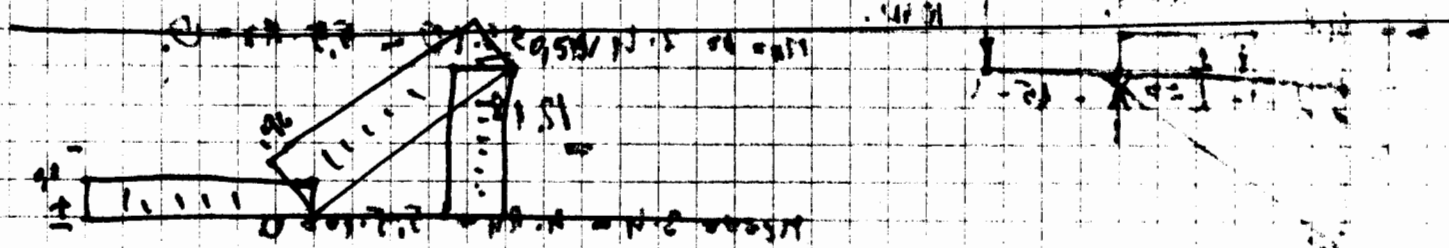
$$\sum M_{A} = 0 \Rightarrow 2 \cdot 0.536 + 5 \cdot 0.536 - 7.5 \cdot B_y = 0$$

$$\uparrow B_y = 0.2144$$

$$\downarrow A_y = 0.18$$

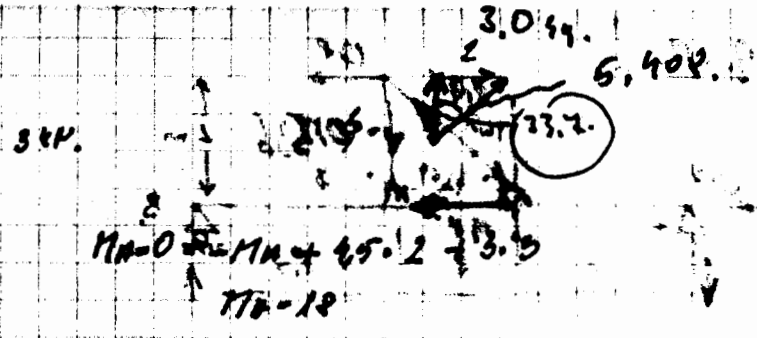
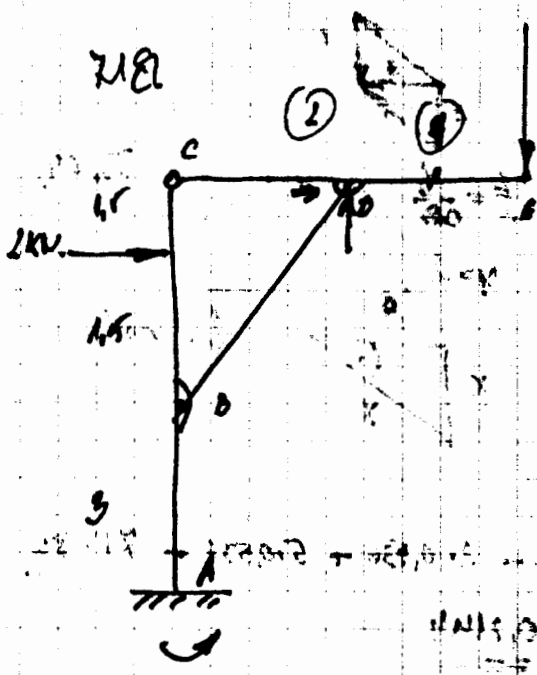
$$\leftarrow A_x = 0.18$$

$$A_x = 2 \cdot 0.18 = 7.5 \cdot B_y = 0$$

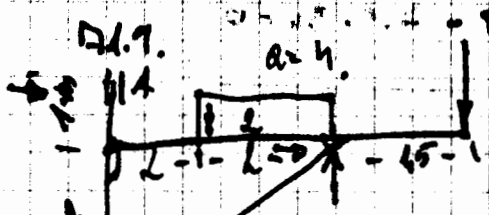


$$M = \int V dx = \int (0.18 - \frac{0.536}{2.5}x) dx = 0.18x - 0.1072x^2$$



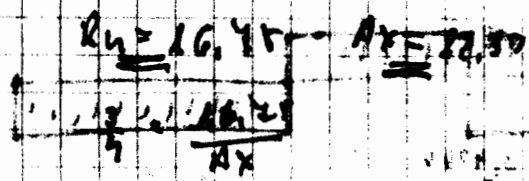


$\sum M = 0$   
 $M_H = 0$   
 $M_H = 2 \cdot 1.5 - R_V \cdot 2 = 0$   
 $R_V = 1.5$   
 $\sum F_H = 0$   
 $2 - R_H = 0$   
 $R_H = 2$



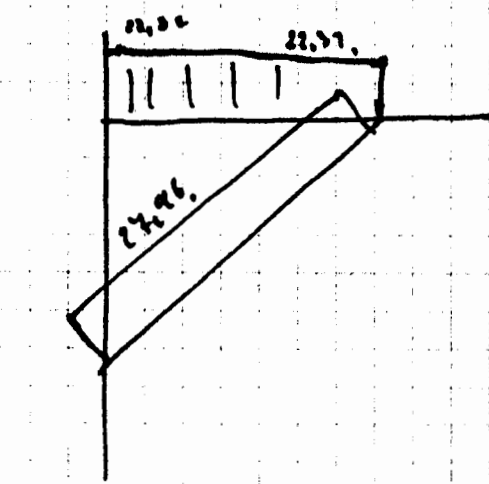
$\sum M = 0$   
 $M_H = 2 \cdot 1.5 - R_H \cdot 3 = 0$   
 $R_H = 1$

$\sum F_H = 0$   
 $2 - R_H = 0$   
 $R_H = 2$

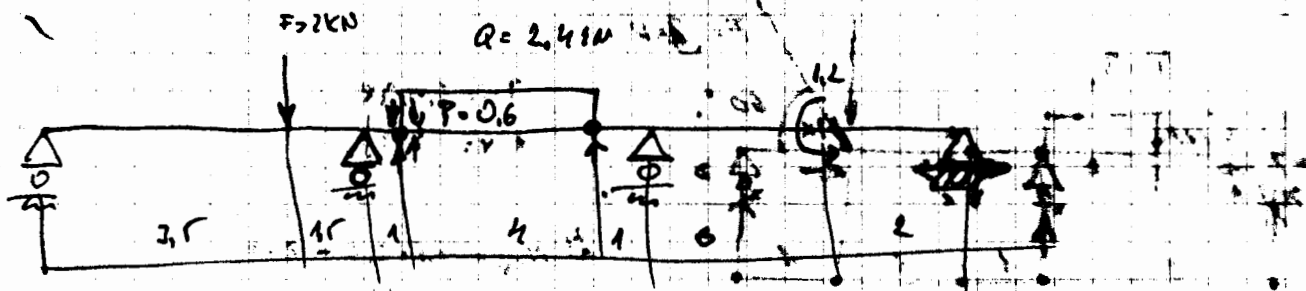


$R_H = 1.5$   
 $R_V = 2.5$

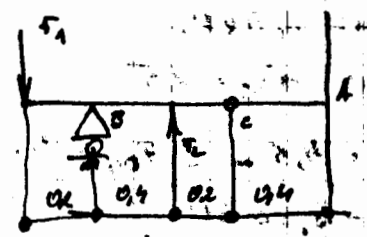
$F_H = 2.5$



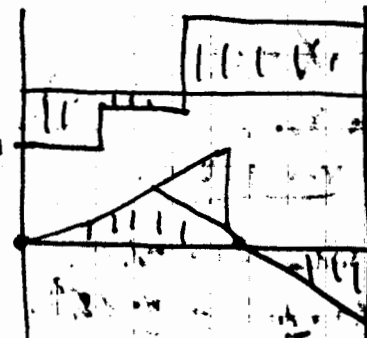
$P_{kin} = \frac{1}{2} S v^2$       $v = \sqrt{\frac{2P}{S}}$       $\frac{1}{2} S \sqrt{\frac{2P}{S}} = P_{kin}$



17.1.



$F = 2 \text{ kN}$   
 $q = 2.4 \text{ kN/m}$



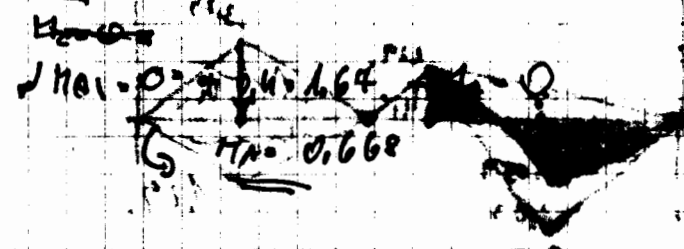
$$\sum M_C = 0 = 0.2 \cdot 2 + 0.4 \cdot 1 + 1.3 \cdot 0.6$$

$$B = \frac{2}{3} \cdot 0.6$$

$$\sum Y_i = 0 = 1 + 0.67 + 2 + 2.4 = 0$$

$$C_y = -2.67$$

$$\sum F_{Ay} = 2.67$$



$$\sum M_C = 0 = 2.4 \cdot 1.67 + 1 \cdot 0$$

$$M_C = 0.668$$

17.2.



$$\sum M_C = 0 = 4 \cdot 4 - 6 \cdot 8$$

$$A_y = 22$$

$$\sum Y_i = 0 = 8 + 12 - 3 = 0$$

$$\sum F_{Ay} = 6.4 - 7.6 = 3$$

$$F_C = 6 \text{ kN}$$

$$\sum Y_i = 0 = 4 - 6 + 7.0 = 0$$

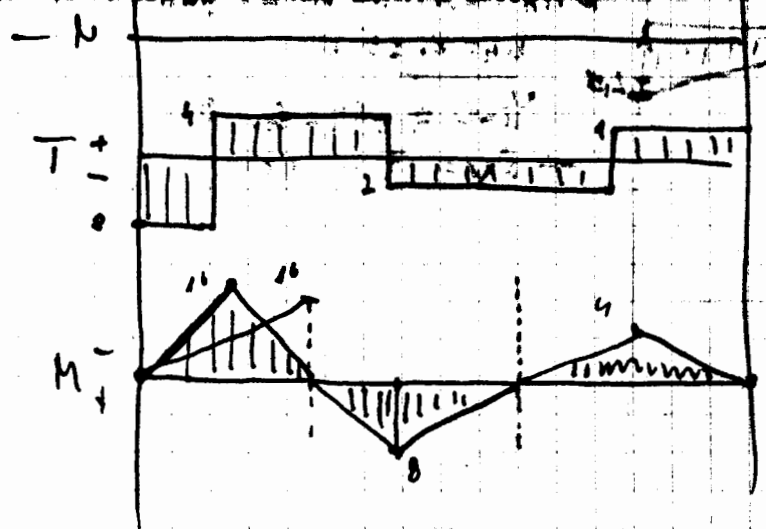
$$B_D = 2$$

$$M_C = 0 = -6 \cdot 2 + F \cdot 4 = 0$$

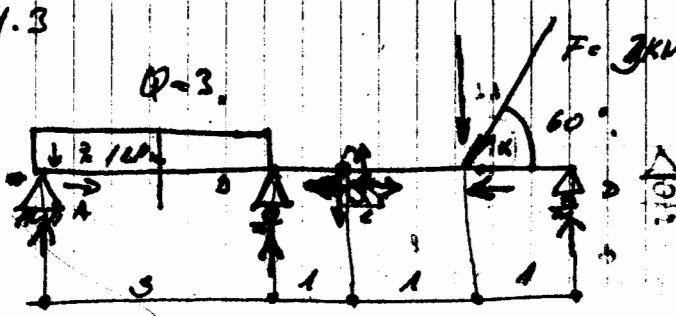
$$F = 3$$

$$\sum Y_i = 0 = -2 + 3 - 7.6$$

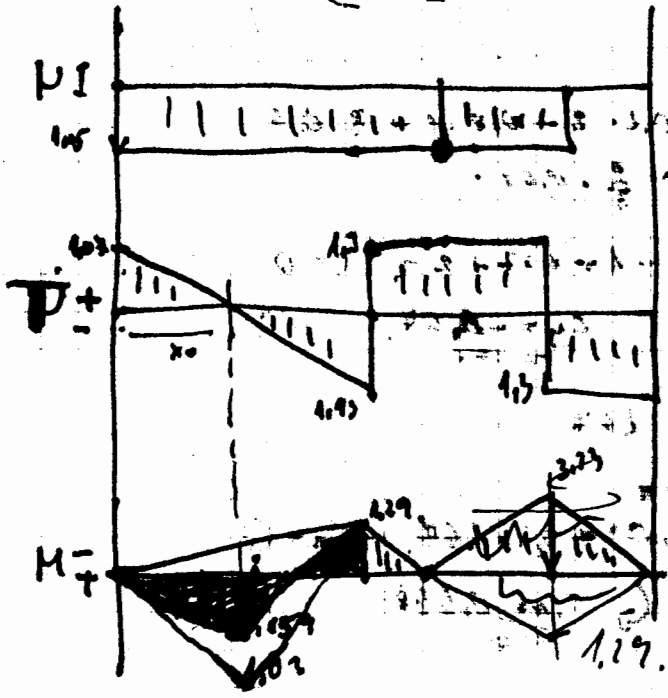
$$F_C = 1$$



A. 1.3



$F_y = 2.5 \text{ kN}$   
 $F_x = 1.5 \text{ kN}$   
 $\sum M_C = 0 = 1 \cdot 2.6 - 2 \cdot 2$   
 $D = 1.3$



$\sum Y_i = 0 = 1.5 - 2.6 + F_{Cy}$   
 $F_{Cy} = 1.1 \text{ kN}$   
 $\sum X_i = 0 \Rightarrow X_C = 1.5$   
 $\sum M_A = 0 = 4.5 - 3 \cdot F_{Cy} + 4 \cdot 1.3$   
 $F_{Cy} = 3.23 \text{ kN}$   
 $\Rightarrow F_{Ax} = 1.5 \text{ kN}$   
 $F_{Ay} = -3 + 3.23 - 1.3$   
 $+ 1.07$   
 $F \cdot P \cdot X = 0$   
 $1.07 = X_0 \cdot 1$   
 $X_0 = 1.07 \text{ m}$

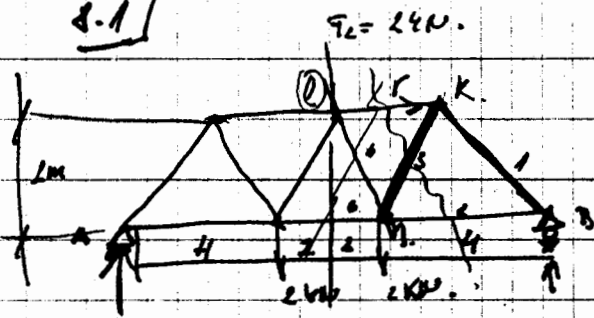
Pr. 1.4  $F = 4.2 \text{ kN} \cdot 1.5$

$Q = 6$



$\sum M_C = 0 = 4.5 \cdot 4.5 - D_y \cdot 3 = 0$   
 $D_y = 2.25$   
 $\sum Y_i = 0 = C_y - 4.5 + 2.25$   
 $C_y = 2.25$   
 $\sum X_i = 0$   
 $\sum M_A = 0 = 4.5 \cdot 4 - D_y \cdot 2 + 3 \cdot 2.25 + 2.5 \cdot 1.5$   
 $D_y = 8.25 \text{ kN}$   
 $Y_i = 0 \Rightarrow D_{Ay} = 4.25$   
 $A_x = F = 4 \text{ kN}$

8.1



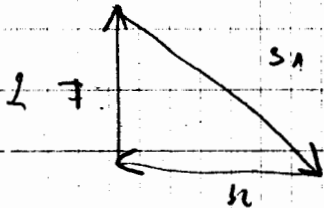
$$\sum M_A = 0 \Rightarrow 6 \cdot 2 + 4 \cdot 2 + 4 \cdot 2 - 12 \cdot D_H = 0$$

$$\uparrow \uparrow D_H = 3 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow A_H = 3 \text{ kN}$$

$$S_2 = 3 \text{ kN} +$$

$$S_1 = 4 \cdot 24 \text{ kN} -$$



$$\sum M = 0 \Rightarrow -3 \cdot 4 + S_3 \cdot 2 = 0$$

$$S_3 = 6 \text{ kN} \ominus$$

$$\sum Y_i = 0 \Rightarrow S_2 = 3 \text{ kN} \downarrow$$

$$\sum Y_i = 0 \Rightarrow S_{2x} = 3 \text{ kN} \rightarrow$$

$$S_2 = 4 \cdot 24 +$$

$$\sum M = 0 \Rightarrow -6 \cdot 3 + 2 \cdot S_6 = 0$$

$$S_6 = 9 \text{ kN} \oplus$$

$$\sum Y_i = 0 \Rightarrow S_{4y} = 3 \text{ kN} \rightarrow$$

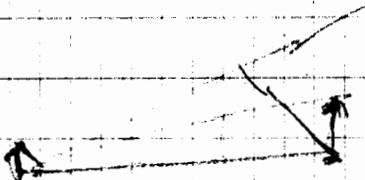
$$\sum Y_i = 0 \Rightarrow$$

$$S_{4y} = 3 \text{ kN} \downarrow$$

$$S_{4y} = 4 \cdot 24 \text{ kN} \ominus$$

6 3 2

5 4, 6



$$\sum M_A = 0 \Rightarrow -4 + 30 - 4 \cdot D_x = 0$$

$$\Rightarrow D_x = 6,5 \text{ kN}$$

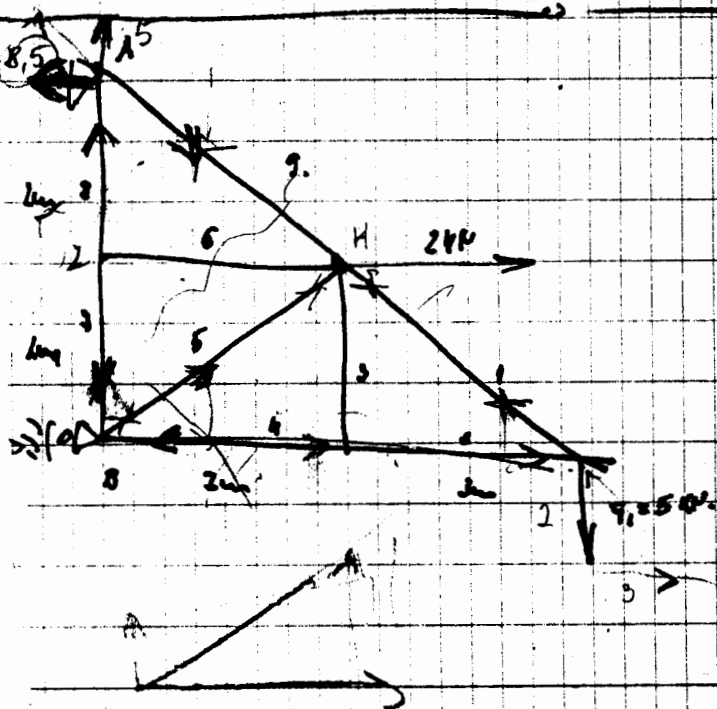
$$\sum Y_i = 0 \Rightarrow A_H = 5 \text{ kN} \uparrow$$

$$\sum Y_i = 0 \Rightarrow A_V = 8,5 \text{ kN}$$

$$\frac{2}{3} = \frac{5}{x} \quad 3,5 \quad S_2 = 4,5$$

$$S_1 = 9,01 \text{ kN}$$

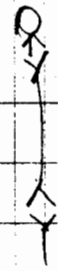
$$S_3 = 0$$



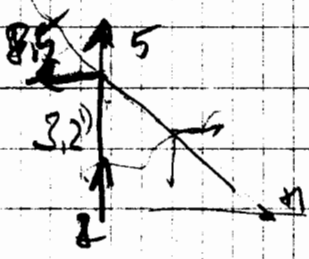
17 3 h) (8.1.1)

$S_4 = 7.5 \text{ MN}$

$\sum X_i = 0 \quad S_3 = 0$   
 $\sum Y_i = 0 \quad S_3 = 0 \quad \left. \vphantom{\sum Y_i = 0} \right\} S_3 =$



8.9



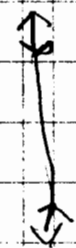
$\sum M_A = 0 \Rightarrow +5 \cdot 3 + 8.5 \cdot 2 + 5.58 = 0$

$S_2 = 2 \text{ MN}$

$S_2 = \sqrt{(5.6)^2 + 8.5^2} = 10.2 \text{ MN}$

9.6.7

$S_6 = 0$   
 $S_7 = \frac{2}{3} \text{ MN}$



4.5.7

$\sum X_i = 0 \Rightarrow S_5 = 1.19$   
 $\sum Y_i = 0 \Rightarrow S_5 = 1.66$

$S_5 = 1.19$

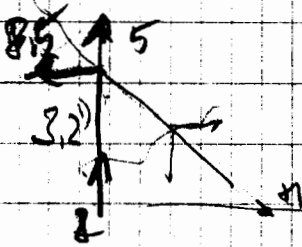
17.3.4) (8.11)

$$S_6 = 7.5 \text{ MN}$$

$$\left. \begin{aligned} \sum X_i = 0 \quad S_3 = 0 \\ \sum Y_i = 0 \quad S_4 = 0 \end{aligned} \right\} S_3 =$$



8.9



$$\sum M_A = 0 \Rightarrow +5 \cdot 3 + 8.5 \cdot 2 + 5.58 = 0$$

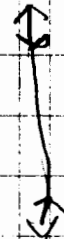
$$S_2 = 2 \text{ MN}$$

$$S_2 = \sqrt{(5.6)^2 + 8.5^2} = 10.24 \text{ MN}$$

9.6.2

$$S_6 = 0$$

$$S_7 = \frac{2}{3} \text{ MN}$$



5.7

$$\sum X_i = 0 \Rightarrow S_5 = 1.19$$

$$\sum Y_i = 0 \Rightarrow S_5 = 1.66$$

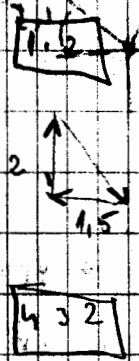
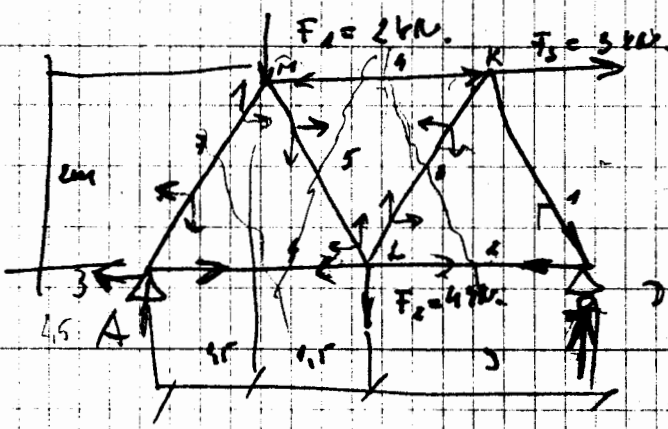
$$\left. \begin{aligned} S_5 = 1.19 \\ S_5 = 1.66 \end{aligned} \right\} S_5 =$$

8.1.2

$$\sum \leftarrow M_A = 0 \Rightarrow 1.5 \cdot 2 + 3 \cdot 4 + 2 \cdot 3 - B_y \cdot 6 = 0 \Rightarrow B_y = 3.5 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow A_y = 2.5 \text{ kN}$$

$$\sum X_i = 0 \Rightarrow A_x = 3 \text{ kN}$$



$$\frac{2}{1.5} = \frac{B_y}{D_x} = \frac{3.5}{D_x} \Rightarrow D_x = 2.625 \text{ kN}$$

$$S_2 = 2.625 \text{ kN} \ominus$$

$$S_1 = \sqrt{2.625^2 + 3.5^2} = 4.375 \text{ kN}$$

$$\sum M_B = 0 \Rightarrow 3 \cdot 2 - 3 \cdot 3.5 + 3.5 \cdot 2 = 0$$

$$S_4 = 2.75 \text{ kN} \ominus$$

$$\sum X_i = 0 \Rightarrow S_{2x} = \leftarrow 2.625 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow S_{2y} = \downarrow 3.5 \text{ kN}$$

$$S_3 = 4.375 \text{ kN} \oplus$$

$$4.5.6 \quad \sum M = 0 = 2 \cdot 3 + 1.5 \cdot 2.5 - 2 \cdot S_6 = 0 \Rightarrow S_6 = 4.875 \text{ kN} \oplus$$

$$\sum Y_i = 0 \Rightarrow S_{5y} = \downarrow 0.5 \text{ kN}$$

$$\sum X_i = 0 \Rightarrow S_{5x} = \rightarrow 0.125 \text{ kN}$$

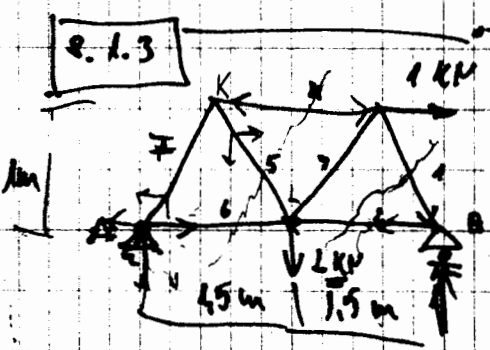
$$S_7 = 0.625 + 4 \text{ kN}$$

$$S_{7x} = \leftarrow 1.875 \text{ kN}$$

$$S_{7y} = \downarrow 2.15 \text{ kN}$$

$$S_{2x} = 3.125 \text{ kN} \ominus$$

8.1.3



$$\sum M_A = 0 \Rightarrow 1 + 3 - B \cdot 3 = 0$$

$$\sum X_i = 0 \Rightarrow A_x = 1 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow A_y = 1 \frac{1}{3} \text{ kN}$$

$$1.2 \quad \frac{1}{0.75} = \frac{4}{S_2} \Rightarrow S_2 = 1 \text{ kN} \quad S_4 = 1.66$$

$$4.5.6 \quad \sum M = 0 \Rightarrow 1 + 0.75 \cdot \frac{1}{3} - S_6 \cdot 1 = 0$$

$$S_6 = 1.5 \text{ kN}$$

$$\sum M = 0 = 1.5 \cdot \frac{1}{3} - 1 \cdot B_y = 0$$

$$S_7 = 1 \text{ kN} \oplus$$

$$S_{5x} = 0.15 \text{ kN}$$

$$S_{5y} = \downarrow \frac{1}{3} \text{ kN}$$

$$S_5 = 0.83 \text{ kN} \oplus$$

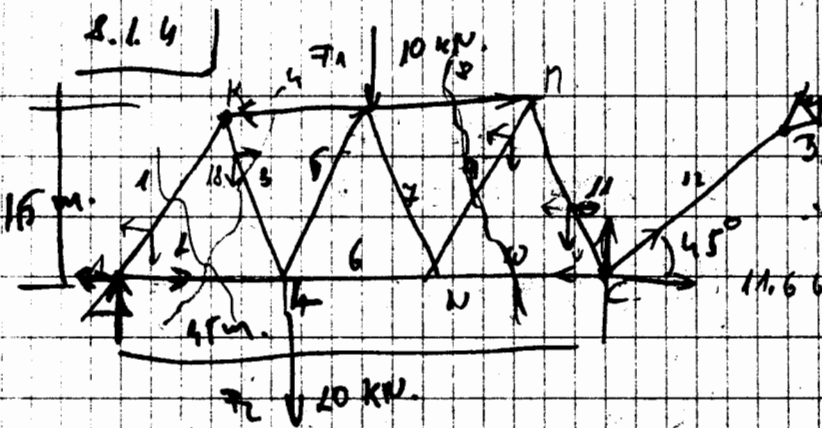
$$S_{7x} = \leftarrow 0.15 \text{ kN}$$

$$S_{7y} = \downarrow \frac{2}{3} \text{ kN}$$

$$S_7 = 0.83 \text{ kN} \oplus$$

$$S_3$$





$$\sum M_A = 0 \Rightarrow 2.25 \cdot 10 + 1.5 \cdot 20 - 4.5 \cdot C_y = 0$$

$$C_y = 11.66$$

$$S_{12} = 11.66 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow A_y = 18.3 \text{ kN}$$

$$\sum M_C = 0 \Rightarrow 1.5 \cdot 11.66 + 0.75 \cdot 10 - 1.5 \cdot S_2 = 0$$

$$S_2 = 20.83 \text{ kN}$$

72

$$S_{14} = 9.16$$

$$S_{15} = 18.3 \text{ kN}$$

$$S_{14} = 20.5 \text{ kN}$$

432

$$\sum M_C = 0 \Rightarrow 1.5 \cdot 18.3 - 1.5 \cdot S_4 = 0$$

$$S_4 = 18.3 \text{ kN}$$

$$S_{13} = 11.33$$

$$S_{14} = 18.3 \text{ kN}$$

$$S_{13} = 21.55 \text{ kN}$$

8910

$$\sum M_D = 0 \Rightarrow -0.75 \cdot 11.66 - 1.5 \cdot 11.66 + 6 \cdot 10 \cdot 1.5 = 0$$

$$S_{10} = 17.5 \text{ kN}$$

$$\sum M_E = 0 \Rightarrow 1.5 \cdot 11.66 + 5.8 \cdot 1.5 = 0$$

$$S_{18} = 11.66 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow S_{19} = 5.83 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow S_{19} = 11.66 \text{ kN}$$

$$S_{19} = 13.03 \text{ kN}$$

111

$$\sum Y_i = 0 \Rightarrow S_{11} = 5.83 \text{ kN}$$

$$\sum M_i = 0 \Rightarrow S_{11} = 11.66 \text{ kN}$$

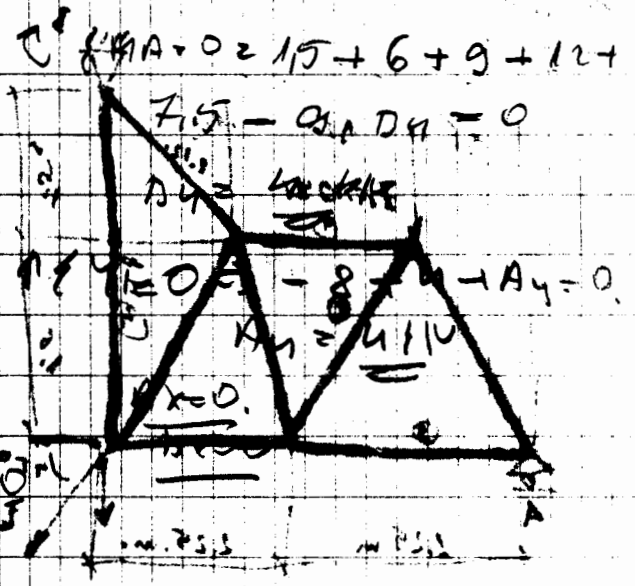
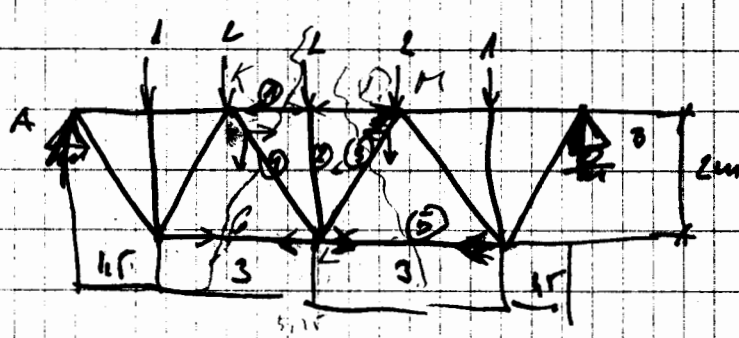
$$S_{11} = 13.04 \text{ kN}$$

56

876

8.2.2

$\sum F_x = 0 = \dots$



141

$\sum M_K = 0 \Rightarrow 4 \cdot 3 - 1.5 - S_6 \cdot 2 = 0$

$S_6 = 5.75$

$\sum M_L = 0$

$\Rightarrow 4.5 \cdot 4 - 3 - 2 \cdot 1.5 - S_1 \cdot 2 = 0$

$S_1 = 6.5$

$S_4 = 0.75$

$S_5 = 1.75$

$1.5 \cdot 2 + 3 \cdot 2 + 4.5 \cdot 1 - 6 \cdot 4 - S_6 \cdot 2 = 0$

$S_2 = 2.4$

135

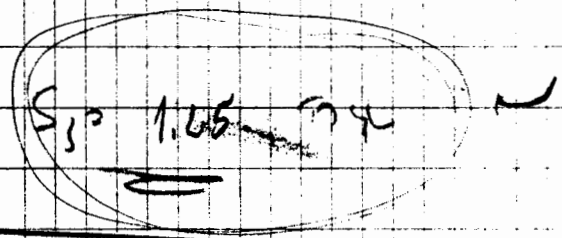
$\sum M_M = 0 \Rightarrow 1.5 - 3 \cdot 4 + 2 \cdot S_5 = 0$

$S_5 = 5.75$

$1.5 \cdot 2 + 3 - 4 \cdot 4.5 + S_1 \cdot 2 = 0$

$S_2 = 0.75$

$S_3 = 1.4$



8.23

~~$S_1 = 4.49$~~

~~$S_2 = 3.0$~~

~~$S_3 = 2.2$~~

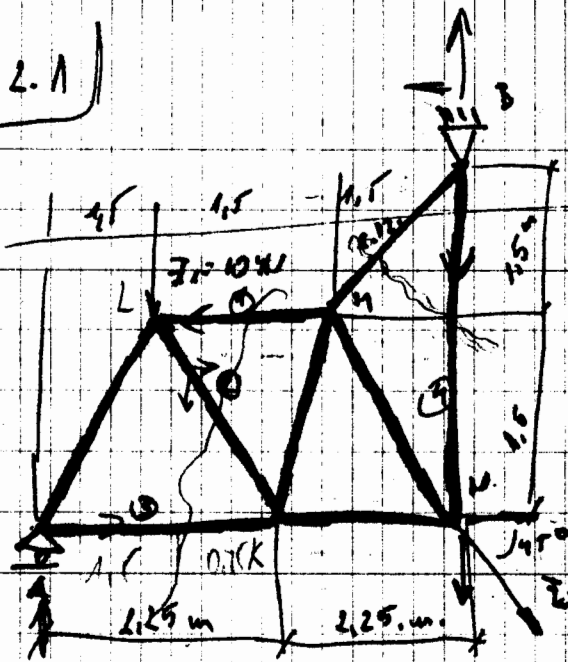
8.24

$S_1 = 3.4$

$S_2 = 0.54$

$S_3 = 0.78$

8.2.1



$$F_{1x} = F_{2y} = 17.071 \text{ kN}$$

$$\sum \epsilon MB = 0 \Rightarrow -7.071 \cdot 3 + 4.5 \cdot A_H = 0$$

$$A_H = 11.38 \text{ kN}$$

$$\sum Y_i = 0 \Rightarrow \uparrow B_H = 5.69 \text{ kN}$$

$$\sum X_i = 0 \Rightarrow \leftarrow A_x = 17.071 \text{ kN}$$

1.23

$$\sum M_L = 0 \Rightarrow +1.5 \cdot 11.38 - 1.5 \cdot S_3 = 0$$

$$S_3 = 11.38 \text{ kN } \oplus$$

$$\sum M_A = 0 \Rightarrow -0.75 \cdot 10 + 2.25 \cdot 11.38 - S_1 \cdot 1.5 = 0$$

$$S_1 = 12.07 \text{ kN } \oplus$$

$$S_{2x} = 0.69 \text{ kN}$$

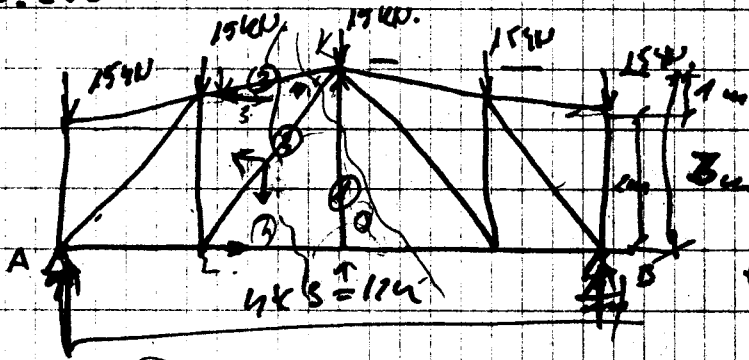
$$S_{2y} = 6.1.38$$

$$\left. \begin{array}{l} S_{2x} = 0.69 \text{ kN} \\ S_{2y} = 6.1.38 \end{array} \right\} \underline{1.5 \text{ kN}} \oplus$$

$$\sum \epsilon M = 0 \Rightarrow -1.5 \cdot 5.69 - 1.5 \cdot 7.071 + S_4 \cdot 1.5 = 0$$

$$S_4 = 12.76 \text{ kN } \oplus$$

8.2.3



$$\sum \{ M_A = 0 \Rightarrow 15 \cdot 3 + 15 \cdot 6 + 15 \cdot 9 + 15 \cdot 12 - 17 \cdot B_A = 0$$

$$B_A = 37,5 \text{ kN}$$

$$\sum \{ Y = 0 \Rightarrow 57,5 + 37,5 - A_A = 0$$

$$A_A = 95 \text{ kN}$$

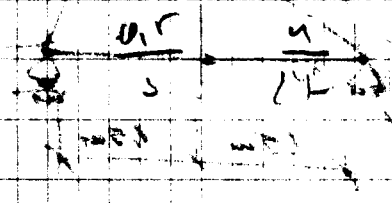
$$\sum \{ X = 0 \Rightarrow A_X = 0$$

235

$$\sum M_L = 3 \cdot 37,5 - 3 \cdot 15 - 25 \cdot S_3 = 0$$

$$S_3 = 27$$

$$S_3 = 27 \text{ kN}$$



$$\sum \{ M_C = 0 \Rightarrow 37,5 \cdot 6 - 15 \cdot 6 - 17 \cdot 3 - 3 \cdot S_4 = 0$$

$$\Rightarrow S_4 = 30 \text{ kN } \oplus$$

$$\sum \{ M = 0 \Rightarrow -15 - 15 - 17,5 + 37,5 - S_2 \cdot 4 = 0$$

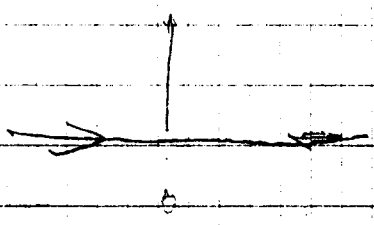
$$S_2 = 3 \text{ kN}$$

$$\sum \{ X = 0 \Rightarrow 27 = 30 + S_2$$

$$S_2 = 3 \text{ kN}$$

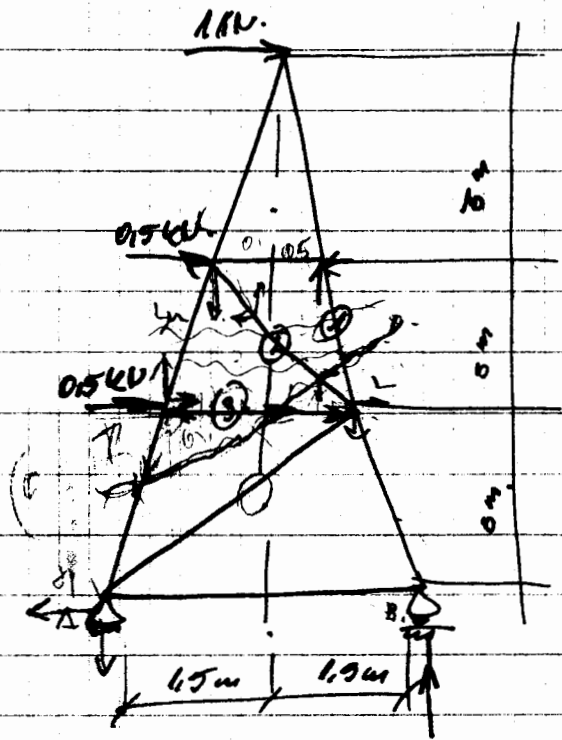
$$S_2 = 7,95 \text{ kN } \oplus$$

$S_1 = 0$



8.2.4

(2)



$$\sum M_A = 0 \Rightarrow 3 \cdot 0.17 + 6 \cdot 0.17 + 9 \cdot 1 = 0$$

$$3 \cdot 34 = 0$$

$$A_{3y} = 4.5 \text{ kN}$$

$$\sum M_B = 0 \Rightarrow A_{1y} = 4.5 \text{ kN}$$

$$\sum M_C = 0 \Rightarrow A_x = -1.2 \text{ kN} (\leftarrow)$$

$$\sum M_D = 0 \Rightarrow 3 \cdot 1 - 1 \cdot 5.4 = 0$$

$$S_{1y} = 3.7 \text{ kN} \quad \ominus S_1 = 3.04 \text{ kN}$$

$$S_{1x} = 0.57 \text{ kN}$$

$$\sum M_E = 0 \Rightarrow 6 \cdot 1 + 3 \cdot 0.5 - 2 \cdot 5.4 = 0$$

$$S_{2y} = 3.75 \text{ kN}$$

$$S_{2x} = 0.625 \text{ kN} \quad S_2 = 3.8 \text{ kN}$$

$$S_{1y} = \uparrow 0.75$$

$$S_{1x} = \leftarrow 0.375$$

$$S_2 = 0.23 \text{ kN} \oplus \leftarrow N$$

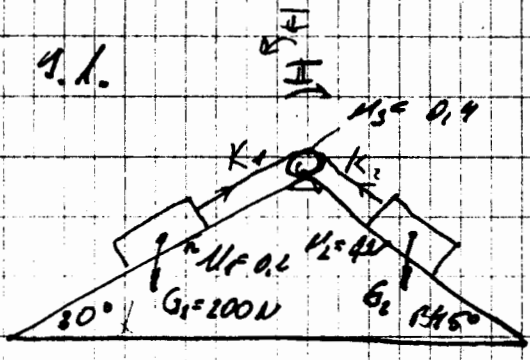
$$\sum M_H = 0 \Rightarrow 3 \cdot 0.5 + 0.5 \cdot 6 + 1 \cdot 9 + 0.375 \cdot 3 + 2.5 \cdot 0.75$$

$$- 0.5 \cdot 3 - 3 \cdot 2.9 - S_3 \cdot 3 = 0$$

$$S_3 = 0.52 \text{ kN} \approx 0.6 \text{ kN}$$

$$3 \cdot 0.17 + 0.17 \cdot 6 + 9 - 0.625 \cdot 6 - 2 \cdot 3.75 + 3 \cdot S_3 = 0$$

4.1.



$\mu_1 = 0.2$

$\alpha = (\alpha + \beta)$

$G_2 \sin \alpha - \mu_1 G_2 \cos \alpha - K_1 = 0$

$K_1 = K_2 \cdot e^{\mu_2 \alpha}$

$K_2 = G_2 \sin \beta + G_2 \mu_2 \cos \beta$

$G_2 \sin \alpha - \mu_1 G_2 \cos \alpha = e^{\mu_2 \alpha} G_2 (\sin \beta + \mu_2 \cos \beta)$

$G_2 \frac{(\sin \alpha - \mu_1 \cos \alpha)}{e^{\mu_2 \alpha} (\sin \beta + \mu_2 \cos \beta)} = G_2 \cdot \min$

$\frac{200 (\sin 30 - 0.2 \cdot \cos 30)}{e^{0.4(75)} (\sin 45 + 0.2 \cdot \cos 45)} = \frac{47.699 \text{ N}}{2 \cdot \min}$

$G_{\max}$

$G_2 \sin \beta - G_2 \mu_2 \cos \beta - K_2 = 0$

$K_2 = K_1 \cdot e^{\mu_2 \alpha}$

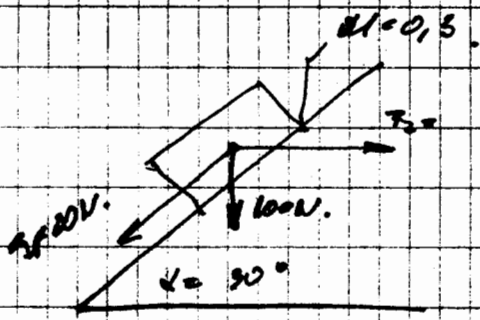
$K_1 = G_1 \sin \alpha + G_1 \mu_1 \cos \alpha$

$G_2 (\sin \beta - \mu_2 \cos \beta) = e^{\mu_2 \alpha} G_1 (\sin \alpha + \mu_1 \cos \alpha)$

$G_2 = \frac{e^{\mu_2 \alpha} G_1 (\sin \alpha + \mu_1 \cos \alpha)}{(\sin \beta - \mu_2 \cos \beta)}$

$G_{2 \max} = \frac{e^{0.4(75)} \cdot 200 (\sin 30 + 0.2 \cdot \cos 30)}{(\sin 45 - 0.2 \cdot \cos 45)}$

$G_{1 \max} = 479.18 \text{ N}$



$F_{2 \text{ min.}}$

.A.A

$$\begin{aligned} \text{○ } F_1 + G \cdot \sin \alpha - F_2 \cdot \cos \alpha - F_2 \cdot \mu \cdot \sin \alpha \\ F_1 + G (\sin \alpha - \mu \cos \alpha) = F_2 \\ \cos \alpha + \mu \sin \alpha \end{aligned}$$

$$\frac{30 + 400 (\sin 30 - 0.3 \cos 30)}{\cos 30 + 0.3 \sin 30} = F_{2 \text{ min.}}$$

$$F_2 = 53.16 \text{ N}$$

$F_{2 \text{ max}}$

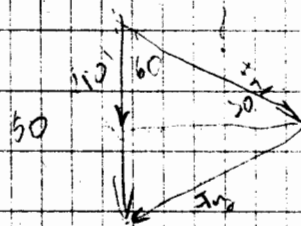
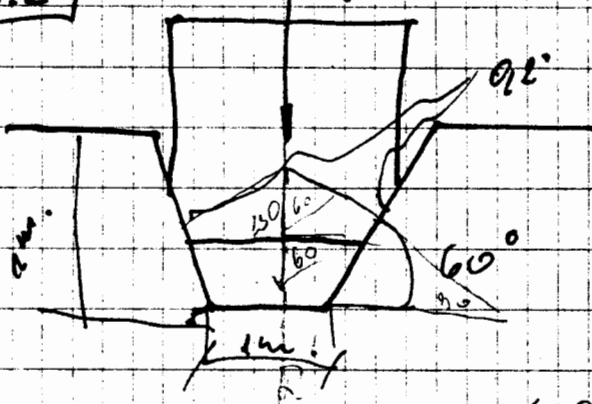
$$F_2 \cos \alpha - F_2 \cdot \mu \sin \alpha - F_1 - G \cdot \sin \alpha - \mu G \cos \alpha = 0$$

$$F_{2 \text{ max}} = \frac{+F_1 + G (\sin \alpha + \mu G \cos \alpha)}{\cos \alpha - \mu \sin \alpha}$$

$$F_{2 \text{ max}} = 148.04 \text{ N}$$

9.2

$Q = 500 \text{ N}$



$= 7500 \text{ N}$

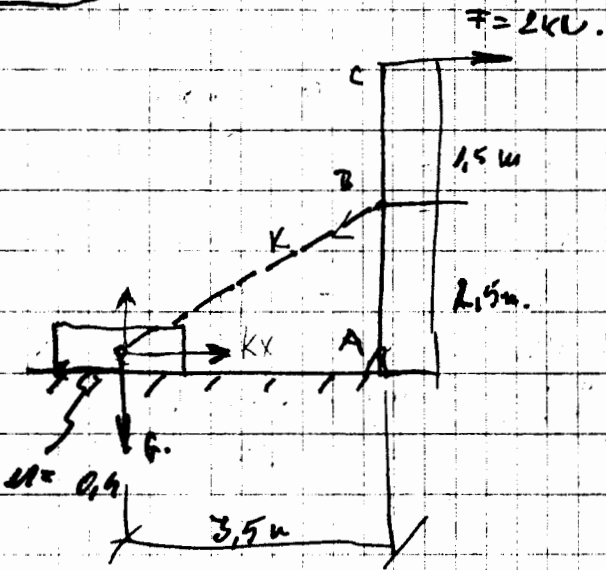
$(F_{y, 0.2} = 200 \text{ N})$

$\text{width} = \frac{Q}{2N}$



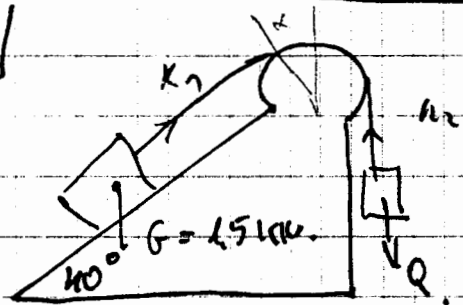
9/3

$\sum \pi A = 0 \Rightarrow$



$$\frac{K_x}{K_y} = \frac{3.2}{0.4} = 8$$

9.4.



$\alpha = 40^\circ$   
 $\mu = 0.25$

$K_1 = 10N$   
 $K_2 = 70.000$   
 $10.112$

Q min.

$G \cdot \sin \alpha - \mu \cdot G \cdot \cos \alpha - K_1 = 0$

$K_1 = K_2 \cdot e^{\mu \theta}$

$K_2 = Q$

Q max

$K_1 = G \cdot \sin \alpha + \mu \cdot G \cdot \cos \alpha$

$K_2 \cdot e^{\mu \theta} = K_1$

$K_2 = Q$

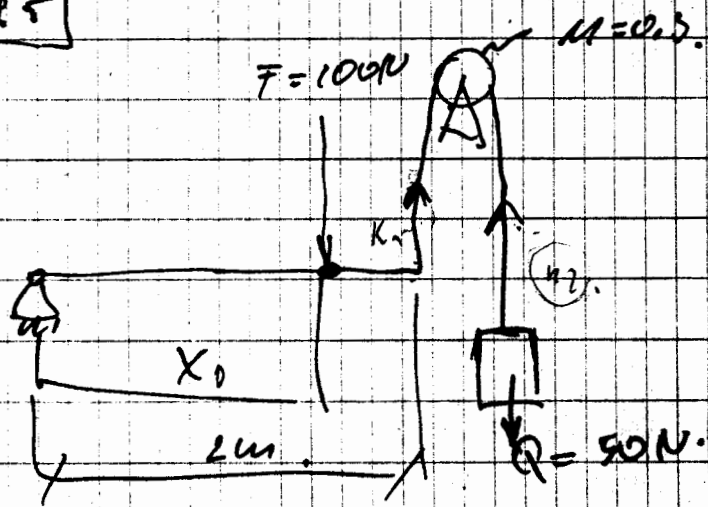
$G (\sin \alpha - \mu \cos \alpha) = Q$

$\frac{1.5 (\sin 40 - 0.25 \cdot \cos 40)}{e^{0.25 \cdot (180)}} = 0.28$

$G (\sin \alpha + \mu \cos \alpha) = Q$

$Q = \frac{1.5 (\sin 40 + 0.25 \cdot \cos 40)}{e^{0.25 \cdot \pi}} = 2.2\%$

95



$$Q = k_2 \cdot 2$$

$$k_2 = k_1 e^{\mu \cdot \pi}$$

$$k_1 \cdot 2 = x_0 \cdot 200$$

$$\frac{Q}{e^{\mu \pi}} = \frac{x_0 \cdot 200}{2}$$

$$\mu = 0.194$$

$$\frac{Q \cdot 2}{e^{\mu \pi} \cdot 200} = x_0$$

$$\frac{50 \cdot 2}{e^{0.17 \cdot \pi} \cdot 200} = \frac{1}{2 e^{0.17 \cdot \pi}} = x_0 \text{ min.}$$

$$k_2 = Q$$

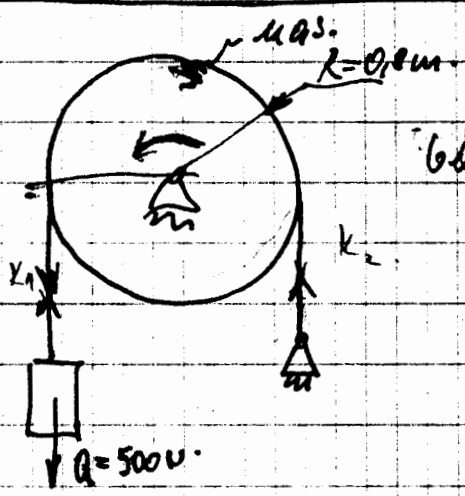
$$k_1 = k_2 e^{\mu \cdot \pi}$$

$$x_0 = \frac{k_1}{100} = \frac{Q e^{\mu \pi}}{100}$$

$$x_0 \cdot 200 = k_1 \cdot 2$$

$$x_0 = 1.283 \text{ m}$$

96.



ball:  $k_2 = k_1 e^{\mu k}$

$$M_B + k_1 \cdot 0.8 = k_2 \cdot 0.8$$

$$M_B = 500 \cdot e^{\mu k} - 500 \cdot 0.8$$

$$M_B = 628 \text{ Nm}$$

ball:  $k_1 = k_2 e^{\mu k}$

$$k_1 \cdot 0.8 = M_B + k_2 \cdot 0.8$$

$$M_B = +k_1 \cdot 0.8 - k_2 \cdot 0.8$$

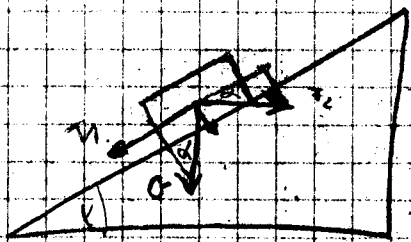
$$M_B = +500 \cdot 0.8 - \frac{500}{e^{\mu k}} \cdot 0.8 =$$

$$M_B = 244 \text{ Nm}$$

9/11

SURLOLOS

ekonomis hotel



10

$$F_1 + P_{sk} = mG \cos \alpha + m F_2 \sin \alpha + F_2 \cos \alpha$$

$$\frac{F_1 + G \sin \alpha - mG \cos \alpha}{m \sin \alpha + \cos \alpha} = F_2$$

$$130 + 50 - 0,3 \cdot 0,866 \cdot 100$$

$$0,3 \cdot 0,5 + 0,866$$

$$= 53,169 \text{ kN}$$

Fed.

$$F_2 \cos \alpha = m F_2 \sin \alpha + mG \cos \alpha - G \sin \alpha + F_1$$

$$F_2 \cos \alpha - m F_2 \sin \alpha = mG \cos \alpha + G \sin \alpha + F_1$$

$$F_2 (\cos \alpha - m \sin \alpha) =$$

$$F_2 = \frac{mG \cos \alpha + G \sin \alpha + F_1}{\cos \alpha - m \sin \alpha}$$

$$\cos \alpha - m \sin \alpha$$

$$F_2 =$$

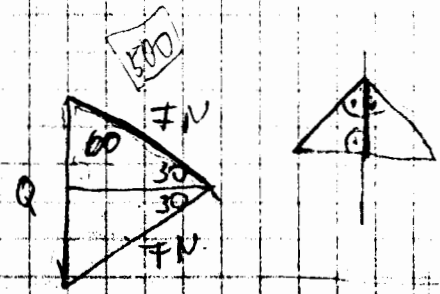
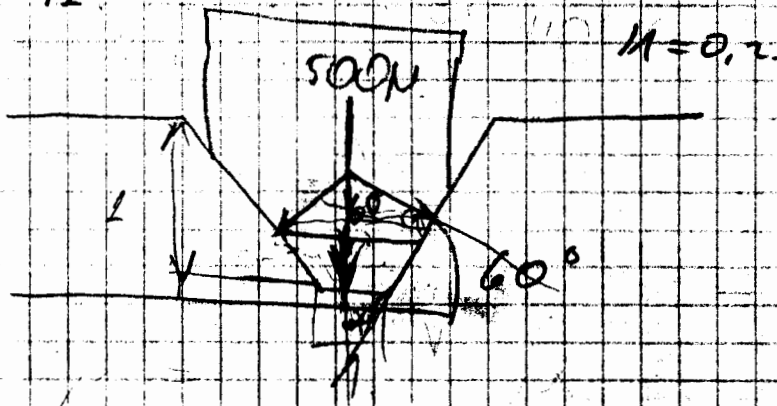
$$0,3 \cdot 100 \cdot 0,866 + 100 \cdot 0,5 + 130$$

$$0,866 - 0,3 \cdot 0,5$$

$$F_2 = 148,016 \text{ kN}$$

11/11  
120 cm  
120 cm  
120 cm  
120 cm  
120 cm

9/2



$$\sin \gamma = \frac{Q}{2N} \quad N = \frac{Q}{2 \sin \gamma} = \frac{500}{2 \cdot 0,2} = 500$$

$$F = F_N \cdot \sin 60^\circ$$

$$F = 500 \cdot 0,2$$

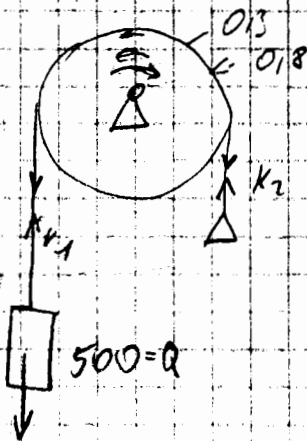
$$F = 200 \text{ N}$$

$$\frac{Q}{F_N} = \cos 60^\circ$$

$$Q = 0,5 F_N$$

$$\frac{Q}{2} = F_N$$

9/6



$$I = K_1 e^{ux} \quad K_2 = K_1 e^{ux}$$

$$M_B + K_1 e^{ux} \cdot 0,2 = -K_1 \cdot 0,8$$

$$M_B = 500 \cdot 0,8 - 500 \cdot e^{ux} \cdot 0,2$$

$$M_B = 400 - 500 e^{ux} \cdot 0,2$$

$$M_B = +626,53 = M_B$$

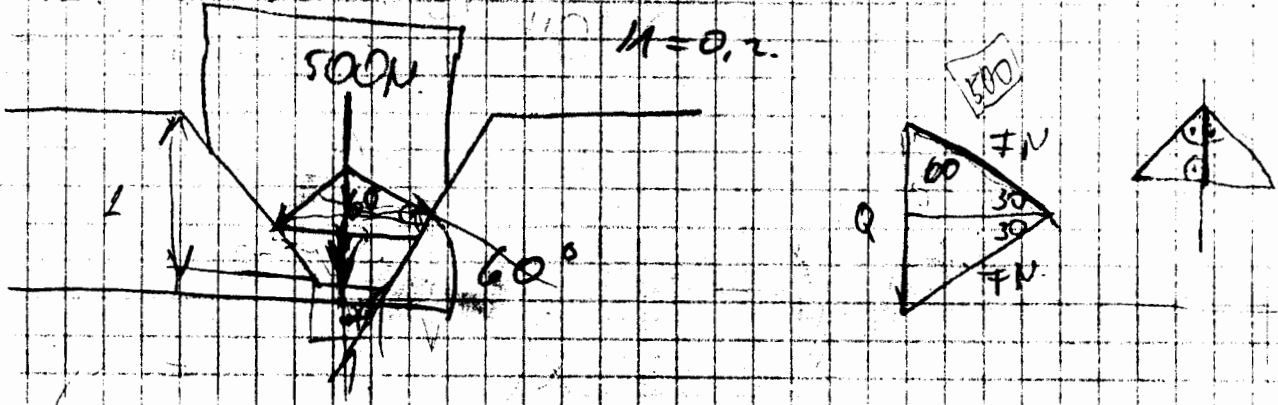
$$M_2 = K_1 \cdot e^{ux} \cdot x$$

$$M_2 + 500 \cdot 0,8 - \frac{K_1}{e^{ux}} \cdot 0,2 = 0$$

$$M_2 = -\frac{500}{e^{ux}} \cdot 0,2 + 500 \cdot 0,8 =$$

$$M_B = -244 = M_2$$

9/2



$$\sin \theta = \frac{Q}{2N} \quad N = \frac{Q}{2 \sin \theta} = \frac{500}{2 \cdot 0,17} = 506$$

$$F = F_N \cdot \mu$$

$$F = 506 \cdot 0,2$$

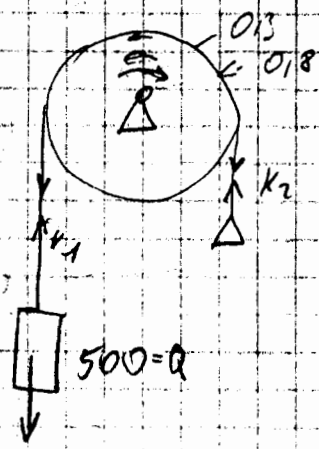
$$F = \underline{\underline{100 \text{ N}}}$$

$$\frac{Q}{F_N} = \cos 60$$

$$Q = 0,5 F_N$$

$$\underline{\underline{\frac{Q}{F_N} = FN}}$$

9/6



$$K_1 = K_2 e^{\mu \alpha} \quad K_2 = K_1 e^{\mu \alpha}$$

$$M_B + K_1 e^{\mu \alpha} \cdot 0,2 = -K_1 \cdot 0,8$$

$$M_B = \frac{500 \cdot 0,8}{400} - 500 \cdot e^{\mu \alpha} \cdot 0,2$$

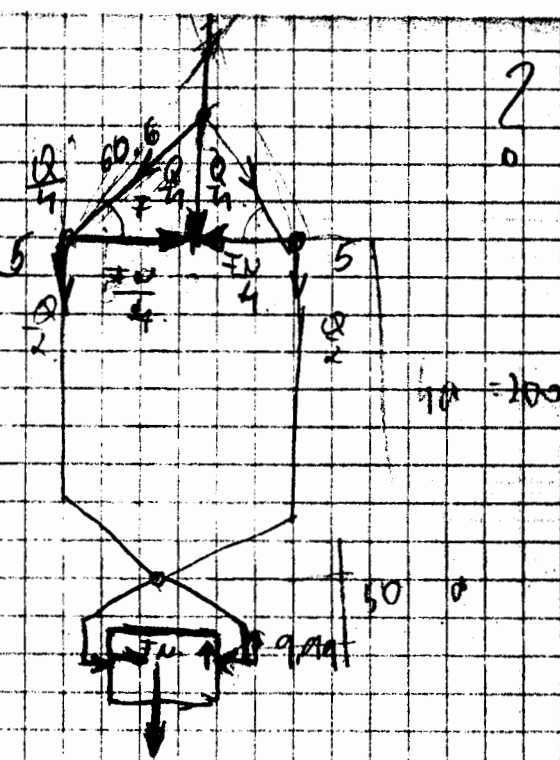
$$M_B = +626,53 = M_B$$

$$K_2 = K_1 e^{\mu \alpha}$$

$$M_3 + 500 \cdot 0,2 - \frac{K_1}{e^{\mu \alpha}} \cdot 0,18 = 0$$

$$M_3 = -\frac{500}{e^{\mu \alpha}} \cdot 0,2 + 500 \cdot 0,2 =$$

$$M_3 = -244 = M_3$$



?

$$4(2 \cdot 90)$$

$$30790 -$$

$$11(120)$$

$$11 \cdot (120 \cdot \frac{4}{100})$$

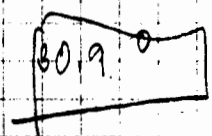
$$Q = 2 [ F \cdot 11 ]$$

$$\frac{Q}{2 \cdot 11} = F$$

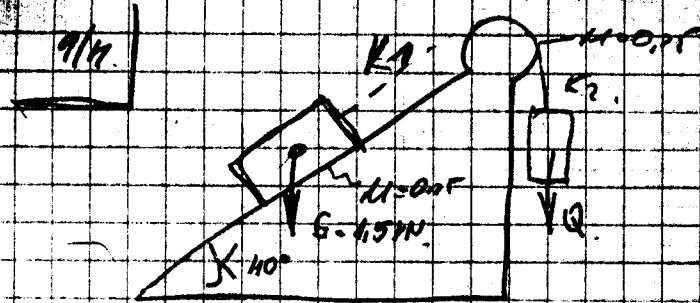
$$\frac{10}{2 \cdot 11} = F \cdot 11 = 33,3$$

$$\frac{Q}{2} = F_3$$

$$\frac{\frac{Q}{4}}{\frac{Q}{2 \cdot 11}} = \frac{\frac{1}{4}}{\frac{1}{2 \cdot 11}} = \frac{1}{1} = 2 \cdot 11$$







$$G \cdot \sin \alpha = G \cdot \mu \cdot \cos \alpha + K_1$$

$$K_1 = K_2 \cdot e^{\mu \alpha}$$

$$K_2 = Q$$

$$G \cdot \sin \alpha = G \cdot \mu \cdot \cos \alpha + K_2 \cdot e^{\mu \alpha}$$

$$G \cdot \sin \alpha - G \cdot \mu \cdot \cos \alpha = Q \cdot e^{\mu \alpha}$$

$$Q = \frac{G (\sin \alpha - \mu \cos \alpha)}{e^{\mu (\alpha + 90^\circ)}}$$

$$Q = \frac{4.5 (\sin 40^\circ - 0.15 \cos 40^\circ)}{e^{0.15 (40^\circ + 90^\circ)}}$$

$$e^{0.15 (40^\circ + 90^\circ)}$$

$$e^{2.2687}$$

$$9.667$$

$$= \frac{60 \text{ N} \cdot 0.07 \text{ kN}}{10 \text{ N}}$$

$$0.38 \text{ kN}$$

$G_{\text{max}}$

$$Q = K_2 \quad K_2 = K_1 \cdot e^{\mu (\alpha + 90^\circ)}$$

$$K_1 = \mu G \cdot \cos \alpha + G \cdot \sin \alpha$$

$$\frac{K_2}{e^{\mu (\alpha + 90^\circ)}} = \mu G \cdot \cos \alpha + G \cdot \sin \alpha$$

$$Q = e^{\mu (\alpha + 90^\circ)} \cdot (\mu G \cdot \cos \alpha + G \cdot \sin \alpha)$$

$$Q = 9.668 \cdot (0.2877 + 0.96413)$$

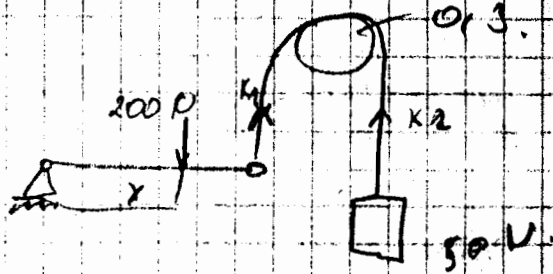
$$Q = 12 \text{ kN}$$

$$\downarrow$$

$$12.28 \text{ kN}$$



9/5



ut.

$$x \cdot 200 = 2 K_1$$

$$K_1 = K_2 e^{2\mu x}$$

$$x = \frac{2 \cdot (50 \cdot e^{2\mu x})}{200}$$

$$K_2 = 50$$

$$K_1 = 50 \cdot e^{2\mu x}$$

$$x = \frac{e^{2\mu x} \cdot 50}{2} = 1.283$$

$$x \cdot 200 = K_1 \cdot 2$$

$$K_2 = K_1 e^{\mu x}$$

$$x = 100 = K$$

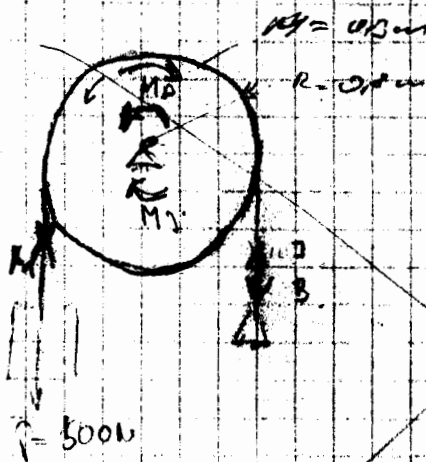
$$K = \frac{K_2}{e^{\mu x}}$$

$$x \cdot 100$$

$$100 \cdot x = \frac{K}{e^{\mu x}}$$

$$x = \frac{50}{e^{2\mu x} \cdot 100} = \frac{1}{e^{2\mu x} \cdot 2} = 0.1742$$

9/6



B.

$$K_1 = K_2 e^{2\mu x}$$

$$M_1 = K_2 \cdot R$$

$$K_1 = K_2 e^{2\mu x}$$

$$M_1 = \frac{500}{e^{\mu x}} = 185.86$$

J

$$K_2 = 100$$

$$K_2 = K_1 e^{\mu x}$$

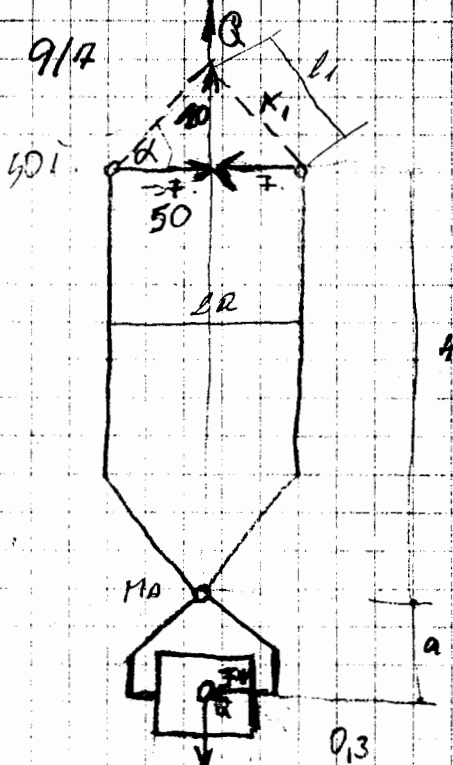
$$M_1 = K_2 \cdot R = 500 e^{\mu x} \cdot 0.8 = 1025.1$$

$$K_2 = K_1 e^{\mu x}$$

$$K_2 = K_1 + 5$$

$$K_2 = K_1 e^{2\mu x}$$

$$K_1 = \frac{K_2}{e^{2\mu x}}$$



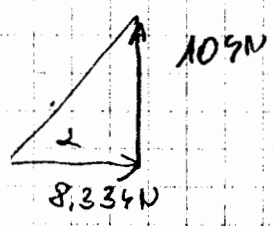
$Q = 20 \text{ kN}$   
 $Q = 50 \text{ cm}$

$4a \cdot F = Q \cdot FN$   
 $4F = FN$

$FN \cdot 0.3 = \frac{Q}{2}$   
 $FN = \frac{Q}{0.3 \cdot 2}$   
 $FN = \frac{20}{0.3 \cdot 2} = \frac{10}{0.3}$

$FN = 33.3 \text{ kN}$

$F = \frac{FN}{4}$   
 $F = \frac{33.3}{4} = 8.33 \text{ kN}$



$\alpha = \frac{10}{8.33} = \sqrt{50.19}$

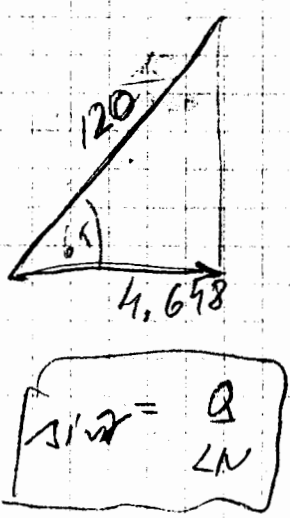
$\sqrt{10^2 + 8.33^2} = K_1 = 13.0 \text{ kN} \quad 13000 \text{ N}$

$4 \cdot F = Q \cdot FN$   
 $F = \frac{Q \cdot FN}{4}$

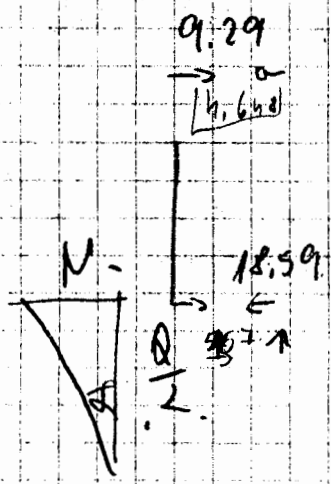
$2FN \cdot 4 = Q$   
 $FN = \frac{Q}{2 \cdot 4} = \frac{20}{8} = 2.5 \text{ kN}$   
 $F = 2.5 \text{ kN}$

$\frac{10}{8.33} = 1.201 = 50.2226^\circ$

$1100 \text{ kPa}$   
 $11000 \text{ N}$   
 $11 \text{ kN}$

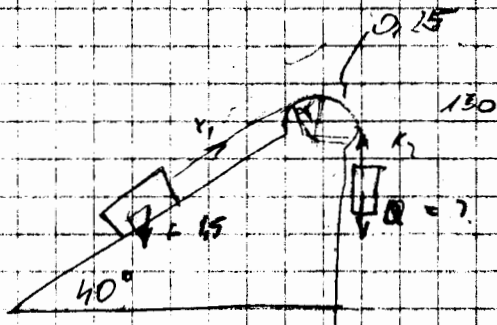


$\sin \alpha = \frac{Q}{2N}$



$\tan \alpha = \frac{Q}{2N}$

$v = m \cdot \frac{Q}{2N}$



1. a)

$$G \cdot \sin 40 = K_1 + \mu \cdot Q \cos 40$$

$$K_1 = G \sin 40 - \mu Q \cos 40$$

$$G (\sin 40 - \mu \cos 40)$$

$$K_1 = K_2 \cdot e^{\mu \cdot 180}$$

$$K_2 = Q$$

$$K_2 = \frac{K_1}{e^{\mu \cdot 180}} \quad K_2 = Q$$

min

$$Q = \frac{G (\sin 40 - \mu \cos 40)}{e^{\mu \cdot 180} - 1}$$

$$\frac{1500 \cdot (0,4512 - 0,271 \cdot 0,567)}{2,71 - 1} = \frac{6176,9}{2,71 - 1}$$

$$= \boxed{3283,9 \text{ N}}$$

$$K_2 = Q$$

$$K_2 = K_1 \cdot e^{\mu \cdot 180}$$

$$Q = K_1 \cdot e^{\mu \cdot 180}$$

$$K_1 = G \cdot \sin 40 + \mu \cdot Q \cos 40$$

$$Q = G (\sin 40 + \mu \cos 40) \cdot e^{\mu \cdot 180}$$

$$\frac{1500 (0,4512 + 0,271 \cdot 0,567)}{2,71 - 1} = \boxed{2203,8 \text{ N}}$$

max  
 $\mu_{1/2} = 24,4 \text{ km/h}$   
 $\mu_{1/3} = 67,4 \text{ km/h}$

max 220

38,4 km/h

100 cm

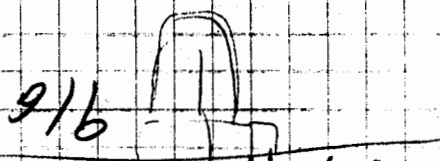
$K_1 = 1,1 \text{ MP}$

max 65°

10,3 MP

From 200 kP

From 148  
 From 2 kP



radius 36 mm

$r = 36 \text{ mm}$

$r = 1,2 \text{ m}$

$r = 0,19 \text{ m}$

9/7

9/5

9/2

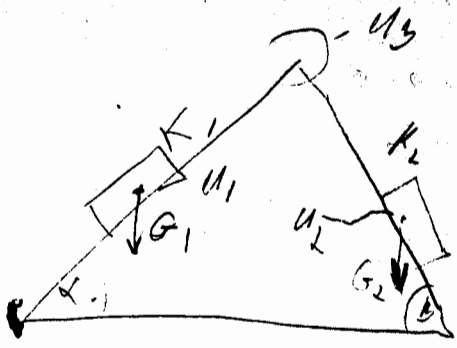
9/1

$$P_{dr} = \frac{S}{2} \cdot v^2$$

$$P_{dr} = S \cdot v^2 + \frac{S}{2} \cdot v^2$$



$$P_{dr} = S \cdot v^2$$



1. ✓

$$G_1 \cdot \sin \alpha = K_1 + G_1 \cos \alpha \cdot M$$

$$K_1 = G_1 (\sin \alpha - \cos \alpha \cdot M)$$

$$K_1 = K_2 \cdot e^{-\mu_2 (k+1)} \quad - \quad K_2 = \frac{K_1}{e^{\mu_2 (k+1)}}$$

$$G_2 \sin \alpha + G_2 \cos \alpha \cdot M = K_2$$

$$K_2 = G_2 (\sin \alpha + M \cos \alpha)$$

$$G_2 = \frac{K_2}{\sin \alpha + M \cos \alpha} = \frac{K_1}{e^{\mu_2 (k+1)} (\sin \alpha + M \cos \alpha)}$$

$$G_2 = \frac{G_1 (\sin \alpha - \cos \alpha \cdot M)}{e^{\mu_2 (k+1)} (\sin \alpha + M \cos \alpha)}$$

$$K_1 = G_1 \sin \alpha + G_1 M \cos \alpha$$

$$K_2 = K_1 \cdot e^{\mu_2 (k+1)}$$

$$G_1 \sin \alpha = G_1 M \cos \alpha + K_2 \quad K_2 = G_2 (\sin \alpha + M \cos \alpha)$$

$$G_1 = \frac{K_2}{\sin \alpha - M \cos \alpha} = \frac{K_1 \cdot e^{\mu_2 (k+1)}}{\sin \alpha - M \cos \alpha} = \frac{G_2 (\sin \alpha + M \cos \alpha) \cdot e^{\mu_2 (k+1)}}{\sin \alpha - M \cos \alpha}$$

121.23 - 4.22.23 + 56.118

$G_1 = 16.31$   
 $F_x = 22.23$   
 $R = 27.91$

$\sum M_G = 0 = 3 \cdot 4 - 54 \cdot 4 + 10 \cdot 3$

---

$F_{Ax} = 12.1818$

$$\sum M_G = 0 = 3 \cdot 4 - 54 \cdot 4 + 5.5 \cdot 10$$



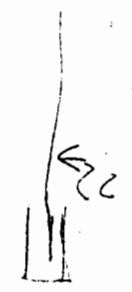
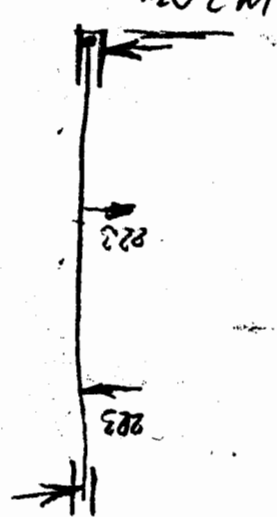


- 1)  $F_{2 \text{ min}} = 53.2 \text{ kP}$   
 $F_{2 \text{ max}} = 141 \text{ kP}$
- 2  $F_{\text{red}} > 200 \text{ kP}$
- 3)  $10.3 \text{ MP}$
- 4  $38.4 \text{ kP min}$   
 $220 \text{ kP max}$
- 5.  $\gamma = 0.195$   
 $\gamma_1 = 1.783$
- 6  $M_{\text{TP}} = 24.4 \text{ kPm}$   
 $M_B = 6.2, 7 \text{ kPm}$

7 =  $\angle 65^\circ$   
 $k_1 = 1.1 \text{ MP}$   
 $120 \text{ cm}$

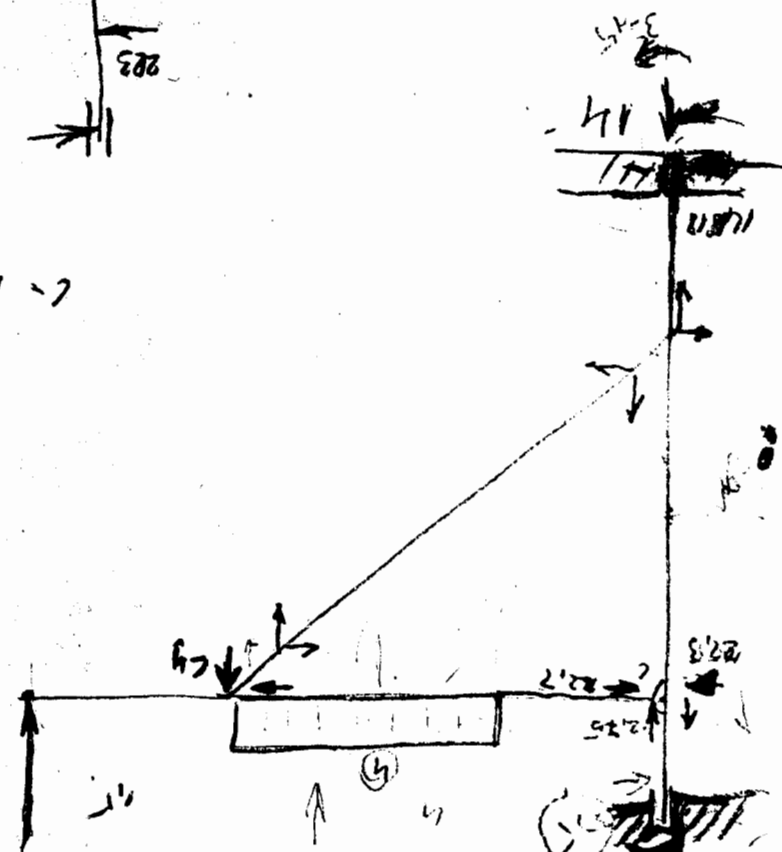
8  $n = 36 \text{ mm}$   
спиральная

141 kP  
141 kP



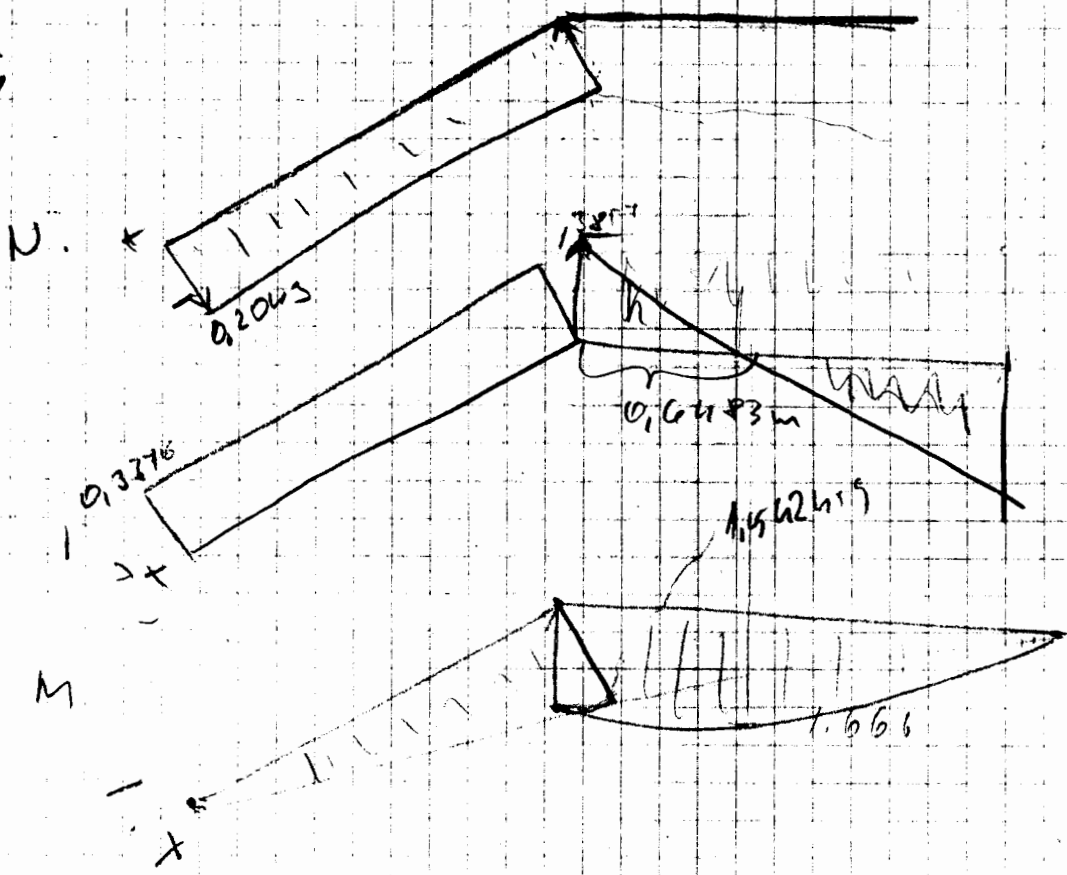
с-17с

$\sum M_C = 0 = 8.4 + 5.570 - 64.4$   
 $E_{\text{H}} = 6.75$   
 $F_R = 22.7$   
 $C_{\text{H}} = 27.01$   
 $\sum X = 0 = 41.00$



10

519

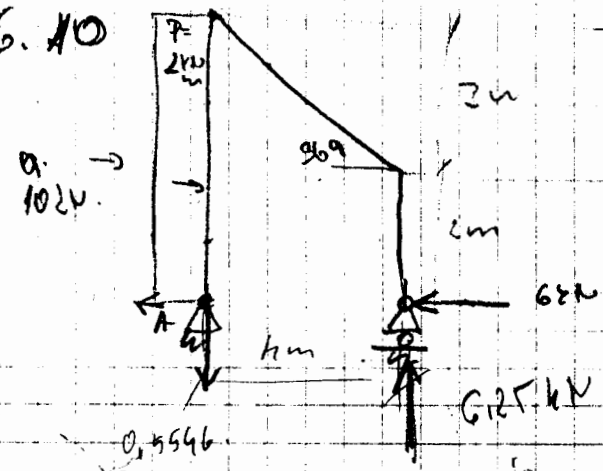


3.35

$2.857 = x \cdot 0.6$

1.666

6.10



$\sum M_A = 0 = 25 - 11 \cdot F_{4B}$

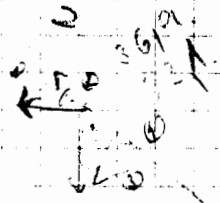
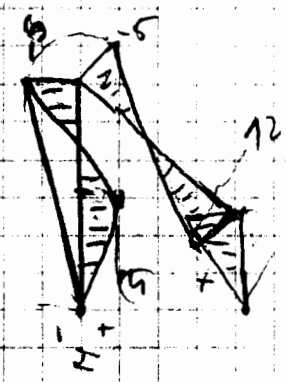
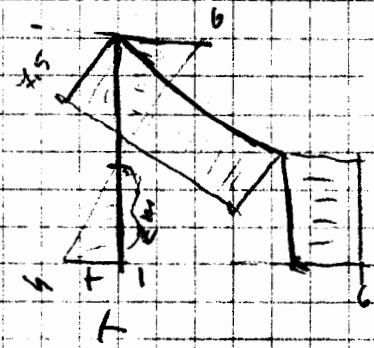
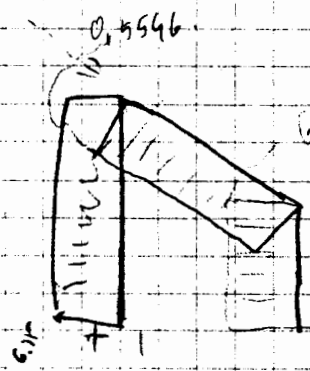
$\leftarrow A_x = 10.6 \text{ kN}$

$\downarrow A_y = 6.75 \text{ kN}$

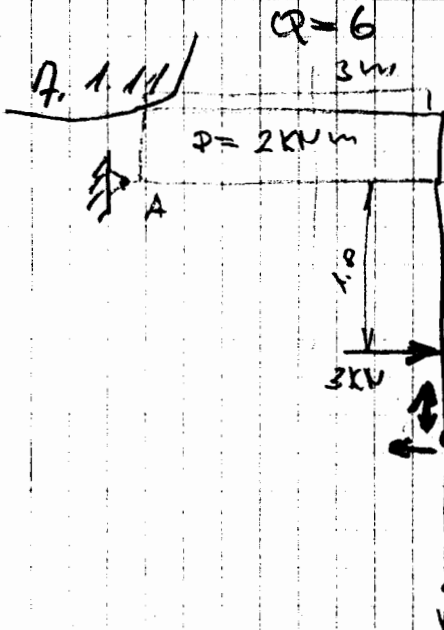
$y = 2 \cdot x$

$8 - \frac{2 \cdot 2^2}{2}$

- 5
- 8
- 12



- ① = 2.4016
- ② = 3.198
- ③ = 4.998
- ④ = 2.7526



$$\sum M_c = 2 \cdot 4 = 3 \cdot B_y = 0$$

$$\sum Y_i = 0 \quad B_y = \underline{\underline{2.66}}$$

$$C_y = \underline{\underline{1.33}}$$

$$M_c = 1.2 \cdot 3 - 1.5 \cdot 6 + A$$

$$\sum M_c = 2 \cdot 4 - B_y \cdot 3 - B_x \cdot 1 = 0$$

$$\sum \Pi_H = 0 = 1.5 \cdot 6 - 1.8 \cdot 3 + 20 - 6 \cdot B_y + B_x \cdot 4$$

$$\sum M_c = 0 = 2 \cdot 4 - 3 \cdot B_y + 1 \cdot B_x = 0$$

$$B_x = +3B_y - 8$$

$$= 9 + 5.4 + 20 - 6B_y + 3(3B_y - 8)$$

$$23.6 + 6B_y - 32 = 0$$

$$6B_y = 8.4$$

$$B_y = \underline{\underline{1.4}}$$

$$10 = 8 - 4.2 + B_x$$

$$\underline{\underline{-32}} = B_x$$

$$\sum Y_i = 0 = -4 + 4 + C_y = 0$$

$$C_y = 2.6$$

$$C_x = 32$$

$$M_{p=0} = 1.5 \cdot 6 - 3 \cdot 1.4 - 3 \cdot B_x = 3B_x$$

$$A_{p=0} = -4 + C_x \cdot 1 + C_y \cdot 3$$

$$C_x = +4 - C_y \cdot 3$$

$$9 - 5.4 - 3C_y - 3(4 - 3C_y)$$

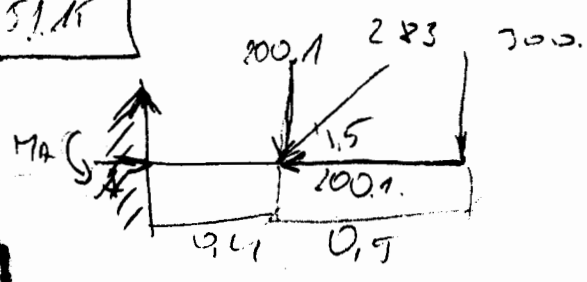
$$9 - 5.4 - 3C_y - 12 + 6C_y$$

$$0 = -2.4 + 3C_y$$



5/16

# Mitlöser



$$\sum M_A = 0 = 0,4 \cdot 200 + 0,9 \cdot 30 - Ay \cdot 0,9$$

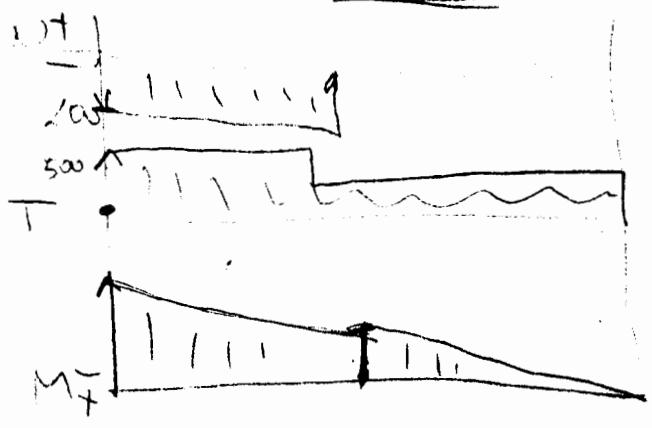
$$Ay = 80 + 270 = 350 \text{ Nm}$$

$$\sum Y_i = 0 = Ay - 200 - 30 = 0$$

$$Ay = 500$$

$$\sum X_i = 0 = Ax - 200 = 0$$

$$Ax = 200$$



$$M = 270$$

$$M_2 = 270$$

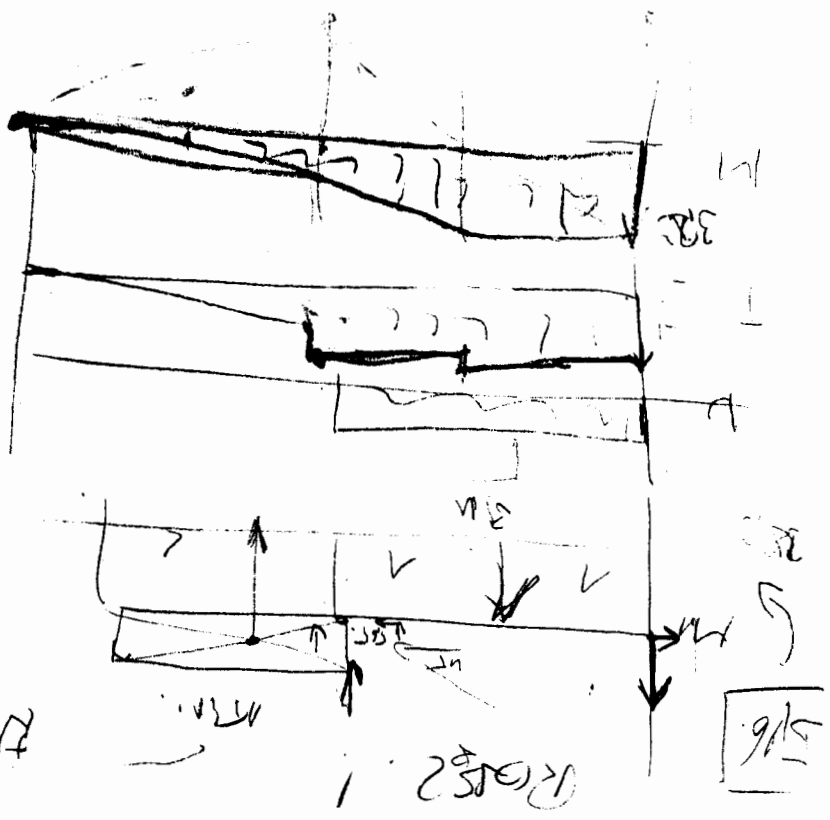
$$M_1 = 38,2 + 2 \cdot 32,66$$

$$Ax = 565$$

$$\sum Y_i = Ay = 32,65$$

$$\sum X_i = 38,2$$

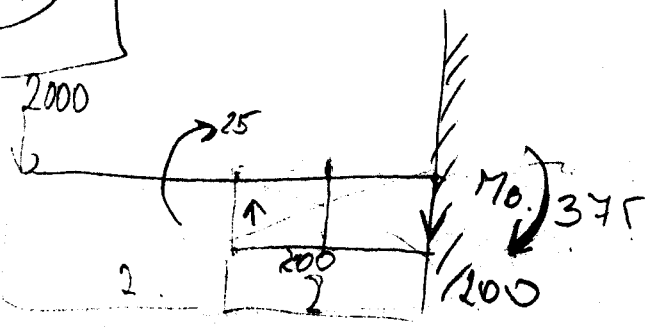
$$\sum M_A = 2 \cdot 51,65 - 1,3 + 3 \cdot 50$$



5/16

5/17

17.

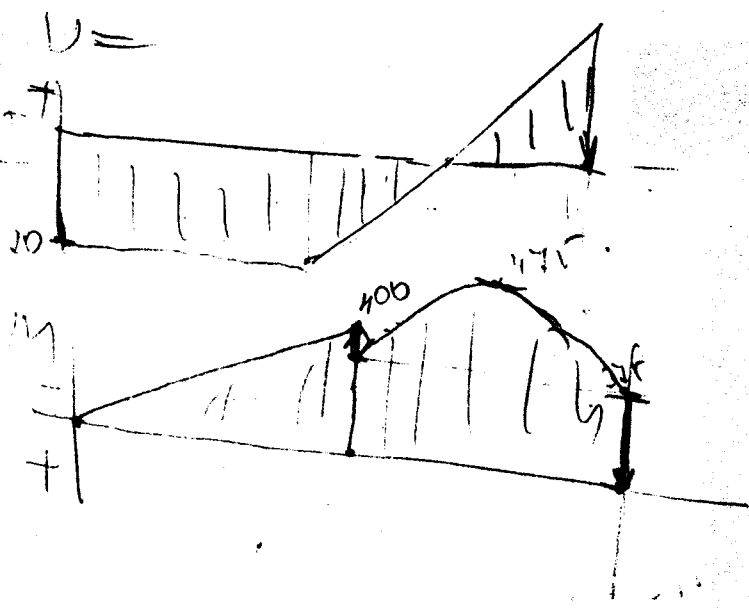


$$M_A = -200 \cdot 4 + 25 + 400 \cdot 1$$

$$= -800 + 25 + 400$$

$$= -375$$

$$\downarrow 200 \quad 400 = \uparrow 20$$



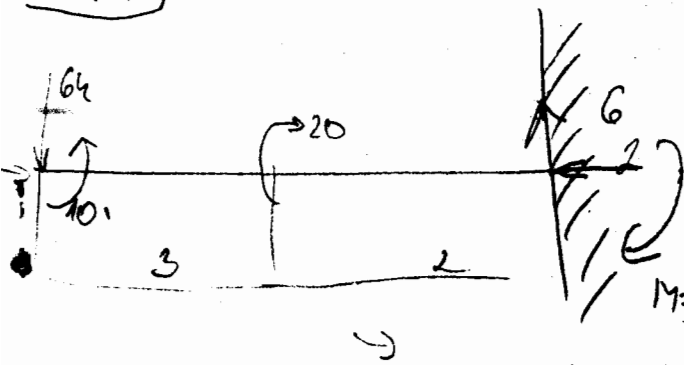
$$-800 + 25 + 400$$

$$= -375$$

$$-800 + 25 + 400$$

$$= -375$$

5.1.18



$$M_D = -6.5 + 10 + 20$$

$$M_B = -30 - 10 + 10$$

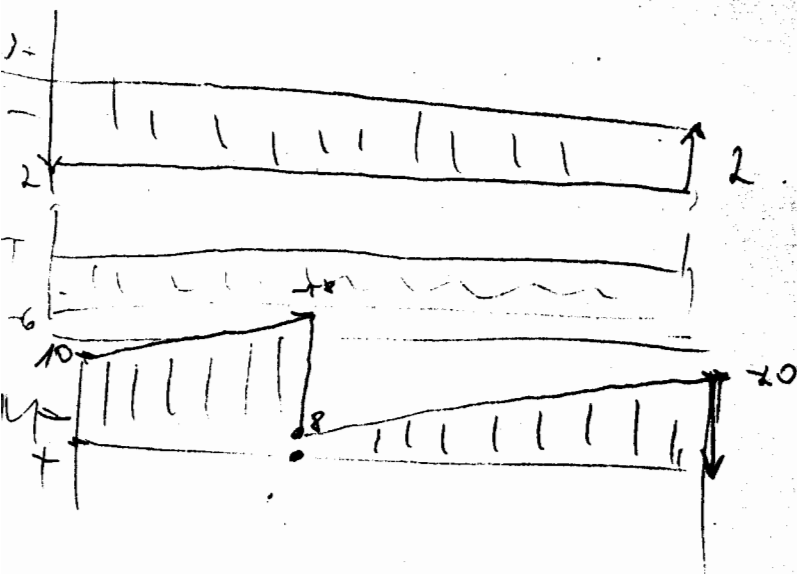
$$= -20$$

$$\frac{18}{2} = 20 \quad \&$$

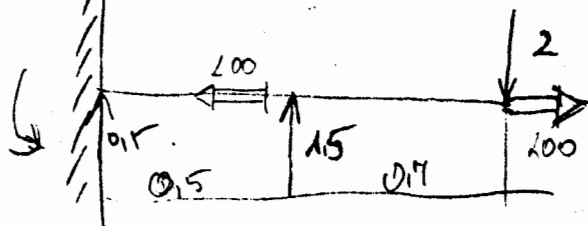
$$-30 - 10 + 20$$

$$= -20$$

$\infty \leftarrow X$   
*Ben*



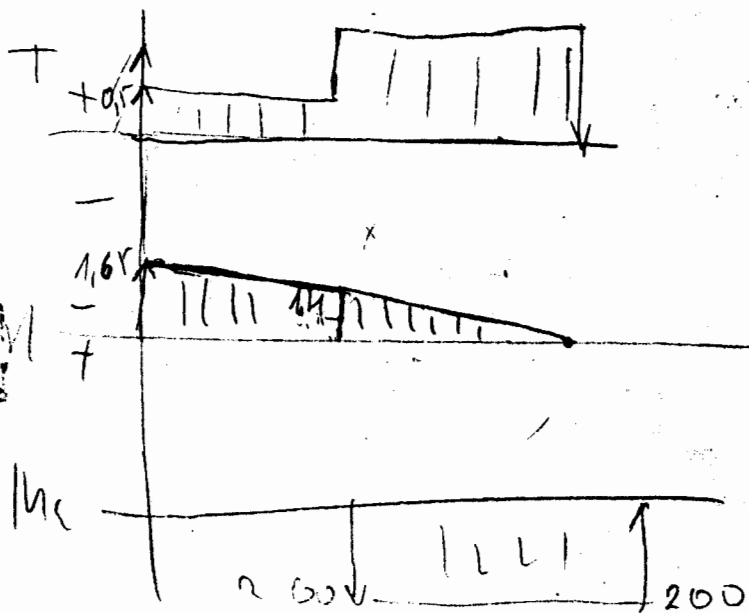
5.1.19



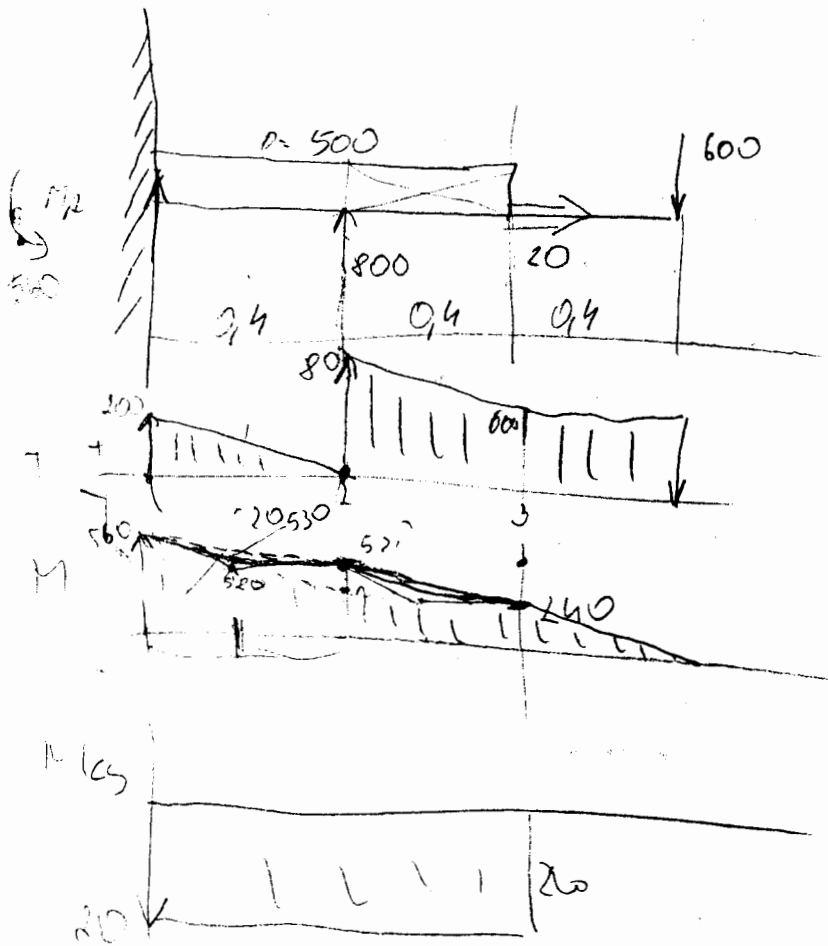
$$M_A = -0.75 + 2.1 = 1.65$$

$$0.5 \cdot 0.75 = 1.65$$

$$0.6 \cdot 0.5 + 0.1 \cdot 1.15 = 1.65$$



5.1.20



$$M_A = +160 + 320 + 720 = 560$$

$$M_{Ay} = 200$$

$$0.2 \cdot 560 + 0.2 \cdot 200 - 10 = -510$$

$$M_2 = 560 + 80 - 40$$

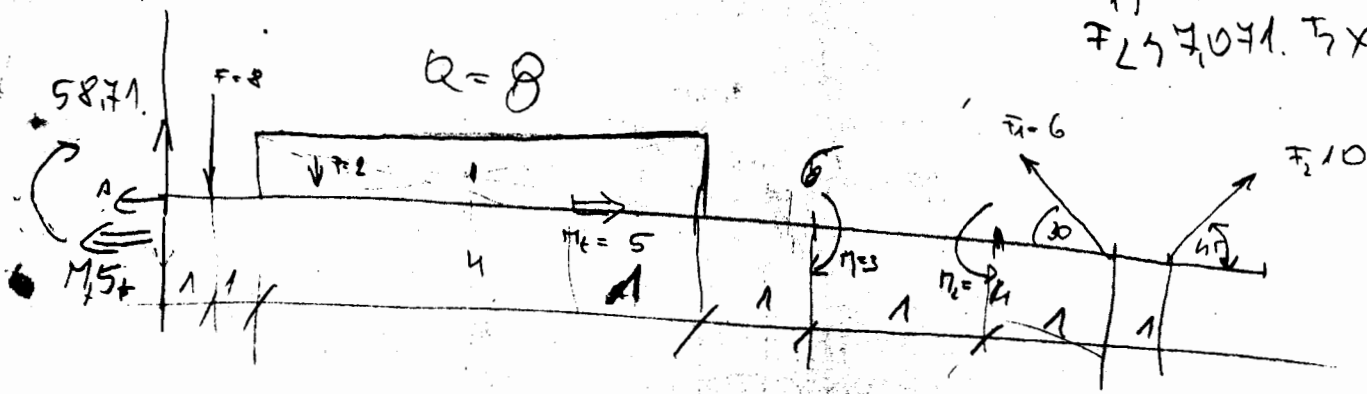
$$M_3 = -560 - 160 + 160 + 310(-240)$$

$$0.6 \cdot 600$$

$$360$$

pl.

$F_{1y} = 3, I_{1x} = 5.29$   
 $F_{2y} = 7.071, F_{2x} = 7.071$

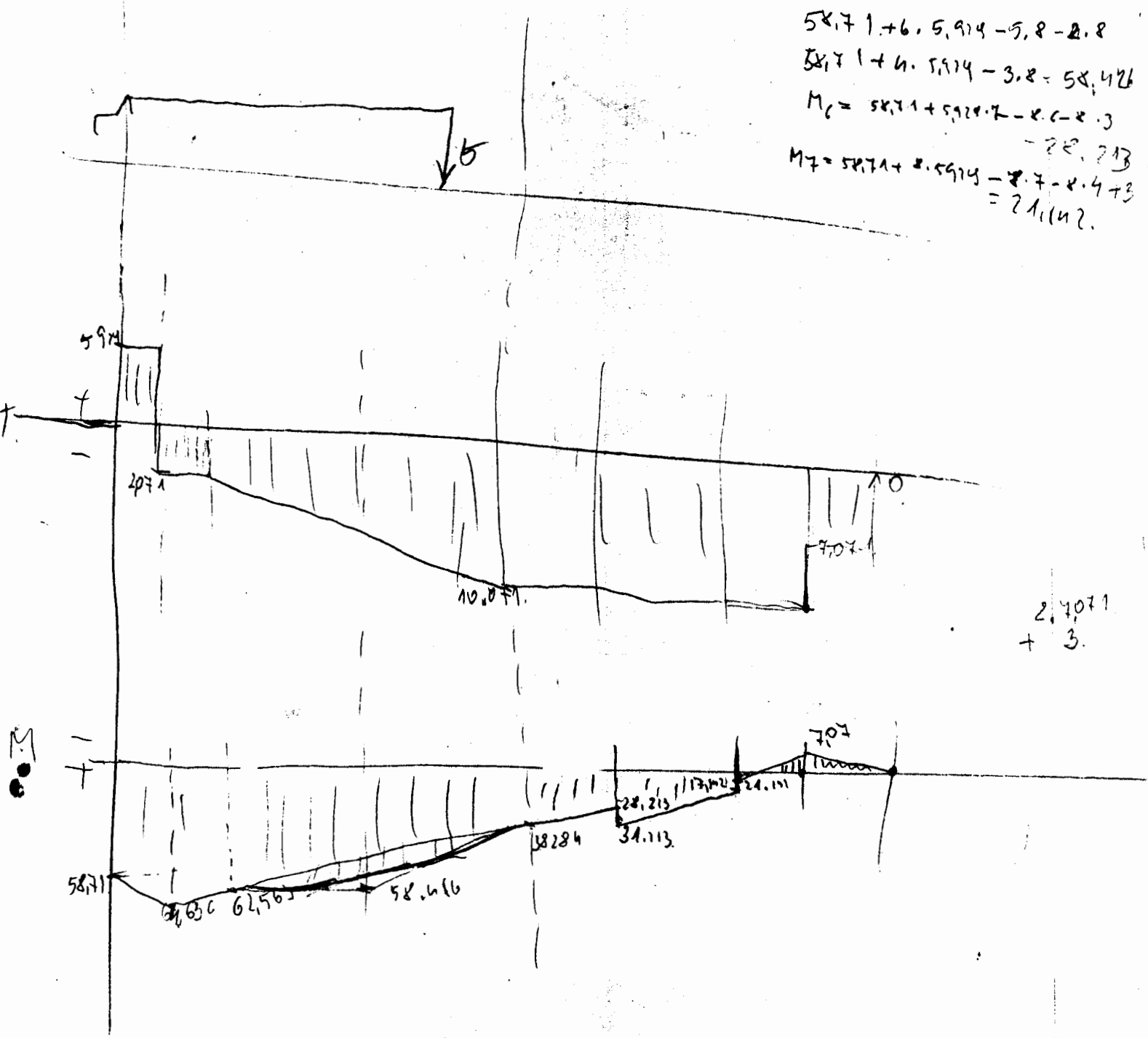


$M_A = -1 \cdot P + 4 \cdot P + 3 - 4 - 9 \cdot 3 - 10 \cdot 7.071$   
 $8 + 32 + 3 - 4 - 27 - 70.71 = -58.71$

$\uparrow F_{Ay} = 5.929$

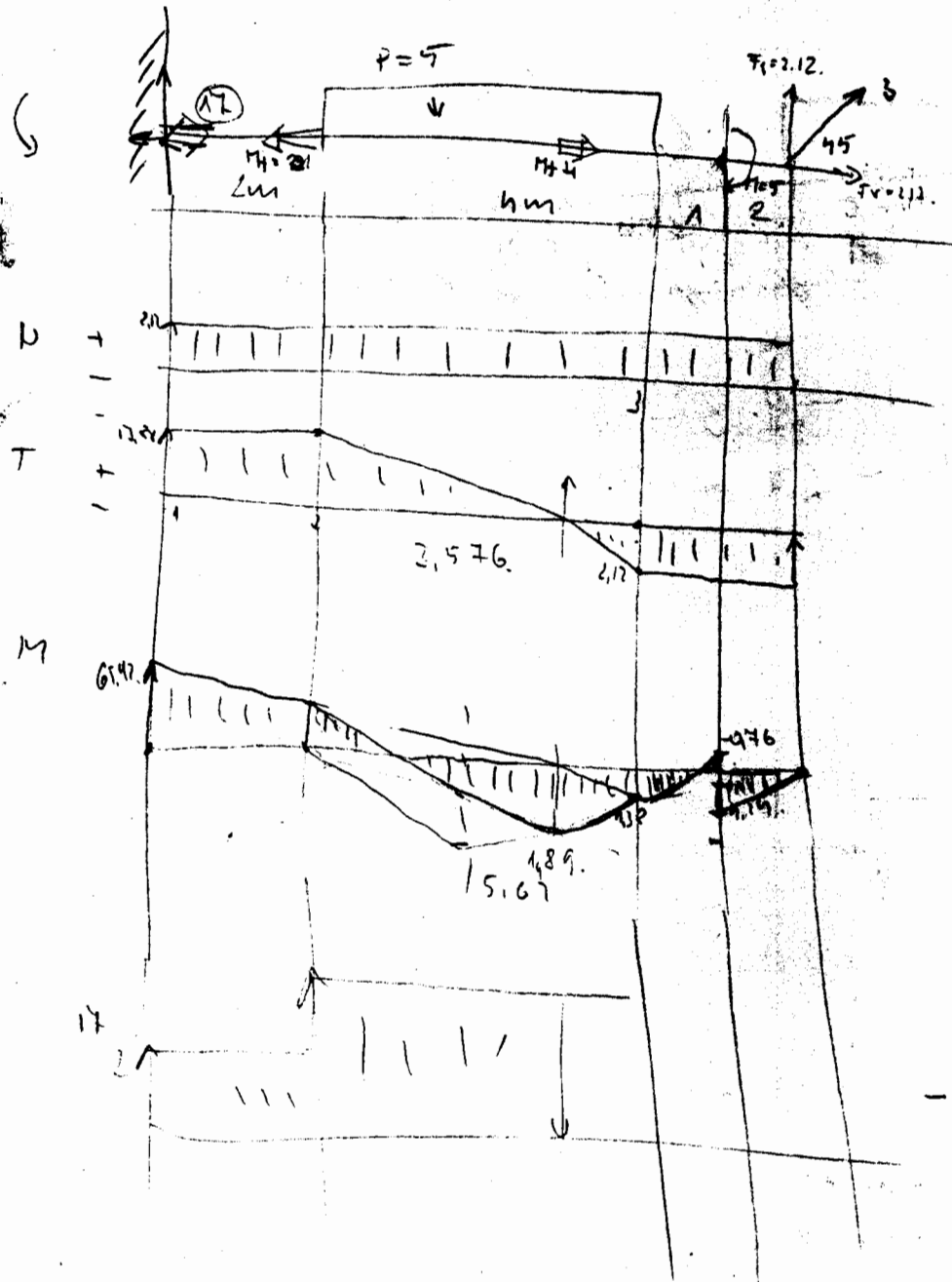
$\leftarrow F_{Ax} = 4.071$

$58.71 + 6 \cdot 5.914 - 5.8 - 2.8$   
 $58.71 + 4 \cdot 5.914 - 3.8 = 58.426$   
 $M_c = 58.71 + 5.929 \cdot 7 - 2.8 - 2.3$   
 $= 78.713$   
 $M_7 = 58.71 + 2 \cdot 5.914 - 2.7 - 2.4 + 3$   
 $= 71.112$



$2 \cdot 7.071 + 3$

R.



$$M_A = 4 \cdot 20 + 5 - 3 \cdot 2.12 - M_A = 0 =$$

$$M_A = 65.92$$

$$R_y = 17.21$$

$$R_x = 2.12$$

$$\textcircled{2} = 30.16$$

$$\textcircled{3} = -65.92 + 6 \cdot 17.21 + 20 \cdot 2$$

$$101.72$$

$$136$$

$$17.22 = 5 \cdot x$$

$$x = 3.576$$

$$-65.92 + 5.576 \cdot 17.22 - \frac{5 \cdot 5.576^2}{2}$$

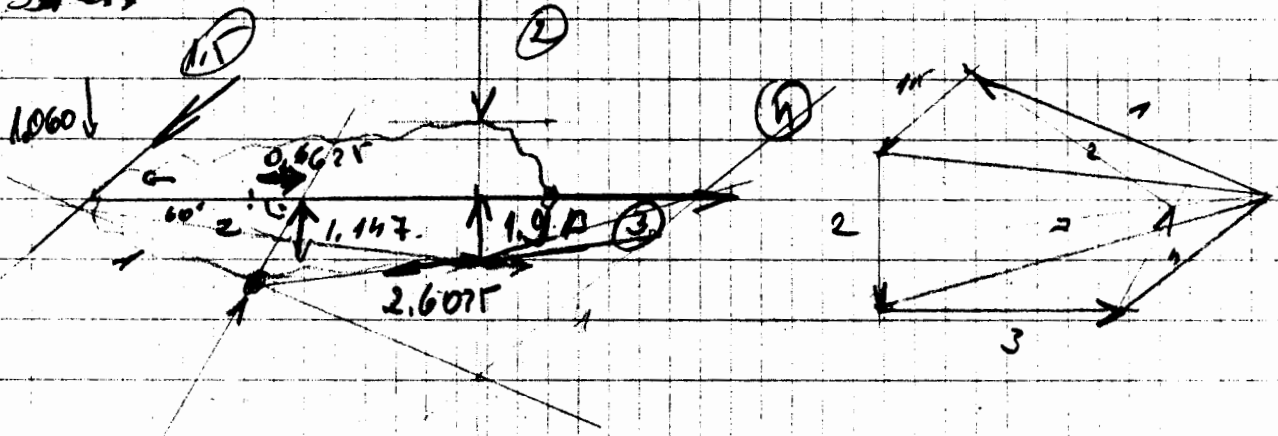
$$-65.92 + 17.22 \cdot 4 =$$

$$5.62$$

$$-65.92 + 7 \cdot 17.22 - 3 \cdot 20$$

$$60$$

3.21



now

$$\boxed{B = 1,375}$$

sums 1,5

$$\boxed{A = 3,779}$$

here

$$\boxed{3,75}$$

$$\sum \tau_i = 0 \Rightarrow A_x = 2,6075$$

$$\sum F_i = 0 \Rightarrow A_y = \underline{\underline{1,917}}$$

2,  
80



# Mechanics.

11/1

$$\epsilon = 9 \cdot 10^{-4} \quad \sigma = 1200 \text{ kp/cm}^2 \quad F = 1440 \text{ kp}$$

11/2  $\sigma = 220$        $\sigma = 1778,8 \text{ kp/cm}^2$

11/3  $\Delta d = 0,0003 \text{ mm}$

11/4,  $r = 0,128 \text{ cm}$

11/5,  $F_{\text{max}} = 4950 \text{ kp.}$

11/6,  $\sigma = 7917 \text{ kp/cm}^2$  New field mech.

11/7,  $d_2 = 5,05$        $\sigma_1 = \sigma_2 = 4009 \text{ kp/cm}^2$ .

11/8  $\sigma = 600 \text{ kp/cm}^2$ .

11/9  $\sigma = 600 \text{ kp/cm}^2$        $F = 6600 \text{ kp.}$

11/10  $F_A = 937,5 \text{ kp.}$        $F_B = 2067,5 \text{ kp}$        $\lambda_K = 8,2 \cdot 10^{-4} \text{ cm}$

11/11  $\tau_{\text{max}} = 318,3 \text{ kp/cm}^2$  mech.

11/12  $\tau_{\text{max}} = 166 \text{ kp/cm}^2$

11/13  $\tau_{\text{max}} = 531 \text{ kp/cm}^2$

11/14  $\tau_{\text{max}} = 884 \text{ kp/cm}^2$        $\lambda = 0,00635 \text{ cm}$   
 $\sigma = 693 \text{ kp/cm}^2$

P. 2.2

$$\begin{aligned}
 S_1 &= 6 \\
 S_2 &= 2 \\
 S_3 &= +1.25 \\
 S_4 &= +1.25 \\
 S_5 &= +5.25
 \end{aligned}$$

P. 2.4

$$\begin{aligned}
 S_1 &= 3.04 \text{ MPa} \\
 S_2 &= -0.84 \\
 S_3 &= -0.5
 \end{aligned}$$

P. 2.3

$$\begin{aligned}
 S_1 &= 0 \text{ MPa} \\
 S_2 &= -0.42 \\
 S_3 &= -2.74 \\
 S_4 &= +3
 \end{aligned}$$

P. 2.4

$$\begin{aligned}
 S_1 &= -1.2 \text{ MPa} \\
 S_2 &= 0.16 \text{ MPa} \\
 S_3 &= +1.14 \\
 S_4 &= 1.25
 \end{aligned}$$

$$\begin{aligned}
 \sum S_i &= 0 \\
 1.5 + 0.15 + 3 &= 0
 \end{aligned}$$

$$\begin{aligned}
 \sum F_i &= 0 \\
 -3 - 1 + 3.8 &= 0 \\
 1.5 + 0.15 + 3.2 + 3.8 - 1 &= 0
 \end{aligned}$$

8.1.2

- S1 = 4.3P MP
- S2 = 2.63
- S3 = 4.37
- S4 = 2.75
- S5 = 0.625
- S6 = 4.875
- S7 = 3.115

8.1.1

- S1 + 9 → MP
- S2 = 7.5 ←
- S3 = 0
- S4 = 7.5
- S5 = 1.2
- S6 = 0
- S7 = +67
- S8 = +67
- S9 = +9.54

8.1.3

- S1 = 1750 S<sub>10</sub>
- S2 = 1250
- S3 = 1500
- S4 = 1000
- S5 = 7500
- S6 = +1600
- S7 = -900

8.1.4

- S1 = 212 MP
- S2 = 12.09 MP
- S3 = 12.12 MP
- S4 = 1.89
- S5 = 0.12
- S6 = 3.01
- S7 = -1.24
- S8 = 1.75
- S9 = 1.24
- S10 = 1.9
- S11 = 1.31
- S12 = 1.76

11/5

$$n = \frac{\sigma_p}{\sigma_{avg}} =$$

$$\sigma_p = n \cdot \sigma_{avg} = 2,2 \cdot 10 \text{ MPa} = 22 \text{ MPa}$$

$$\sigma = \frac{F}{A} \quad F = \sigma \cdot A = 22 \cdot 10^6 \cdot 17671 \cdot 10^{-6}$$

$$= 388772 \cdot 10^5 \text{ N}$$

11.6.

$$\sigma = \frac{F}{A} \quad F = \sigma \cdot A = 125 \cdot 10^6 \cdot 1200 \cdot 10^{-6} = 150 \cdot 10^3 \text{ KN}$$

$$\sigma = \frac{95 \cdot 10^3}{1200 \cdot 10^{-3}} = 79167 \cdot 10^3 \frac{\text{N}}{\text{m}^2}$$

$$\lambda = \frac{F_1 \cdot R}{A_1 \cdot E} = \frac{F_2 \cdot R_2}{A_2 \cdot E}$$

$$A_1 = 30$$

$$\frac{F_1}{A_1} = \frac{F_2}{A_2} = \frac{F_2 \cdot A_1}{F_1} = A_2$$

$$A_2 = \frac{80 \cdot 10^3 \cdot 0,706 \cdot 10^{-3}}{40 \cdot 10^3}$$

$$A_2 = 1,412 \cdot 10^{-3} \text{ m}^2 = \frac{d^2 \cdot \pi}{4}$$

$$\frac{1,412 \cdot 10^{-3} \cdot 4}{\pi}$$

$$d = 42,401 \text{ mm}$$

$$\sigma = \frac{F}{A} = \frac{80 \cdot 10^3}{1,412 \cdot 10^{-3}}$$

$$56 \cdot 10^6 \frac{N}{m^2}$$

$$\sigma_1 = \frac{40 \cdot 10^3}{1,06 \cdot 10^{-3}}$$

$$= 3,773 \cdot 10^6 \frac{N}{m^2}$$

$$\Delta l = \alpha \cdot l \cdot \Delta t$$

$$\frac{\sigma}{E} = \alpha \cdot \Delta t$$

$$\sigma = E \cdot \alpha \cdot l \cdot \Delta t = 200 \cdot 10^9 \cdot \frac{1,5 \cdot 10^{-5} \cdot 20}{1}$$

$$= 6,1 \cdot 10^7 \frac{N}{m^2}$$

$$11/9 \quad \sigma = F/A$$

$$\Delta l = \alpha \cdot l \cdot \Delta t$$

$$\Delta l_1 = 1,15 \cdot 10^{-5} \cdot 25 \cdot 40 + \Delta l_2 = 1,15 \cdot 10^{-5} \cdot 25 \cdot 40$$

$$\Delta l = 2,31 \cdot 10^{-2} m$$

$$10 cm = 10 \cdot 10^{-2}$$

$$2,31 cm = \underline{23,9 \mu m}$$

$$-h = \underline{19,1 \mu m}$$

$$\sigma = \frac{F}{A}$$

$$\sigma = \frac{20836}{1,15 \cdot 10^{-3}}$$

$$\lambda = \frac{l \cdot F}{E \cdot A}$$

$$F = \frac{\lambda \cdot E \cdot A}{l} = \frac{2,31 \cdot 10^{-2} \cdot 200 \cdot 10^9 \cdot 1,100 \cdot 10^{-3}}{50}$$

$$F = 0,0836 N$$

50

$$A_2 = \frac{40^2 \cdot \pi}{4} = 1256.63 \cdot 10^{-6} \text{ m}^2$$

$$A_1 = \frac{20^2 \cdot \pi}{4} = 314.15 \cdot 10^{-6} \text{ m}^2$$

11/10

$$T = F_D + T_A$$

$$F_D = F - F_A$$

$$\frac{F_A \cdot l_1}{E \cdot A_1} = \frac{(F - F_A) \cdot l_2}{E \cdot A_2} \Rightarrow F_A = \frac{F \cdot l_2}{A_2 \left( \frac{l_1}{A_1} + \frac{l_2}{A_2} \right)}$$

$$= \frac{30 \cdot 10^3 \cdot 0.2}{1256.63 \cdot 10^{-6} \left( \frac{0.15}{314.15 \cdot 10^{-6}} + \frac{0.2}{1256.63 \cdot 10^{-6}} \right)}$$

$$= 7.45 \cdot 10^3$$

$$F_B = \underline{\underline{225 \cdot 10^4 \text{ N}}}$$

$$\lambda = \frac{2.25 \cdot 10^5 \cdot 0.1}{1156 \cdot 10^{-6} \cdot 200 \cdot 10^3} \cdot 10^1$$

$$\lambda = 8.9 \text{ mm} \cdot 10^{-3}$$

11/14

$$T_{\text{max}} = \frac{V}{A} = \frac{60 \cdot 10^3}{2.3 \cdot \frac{12^2 \cdot \pi}{4} \cdot 10^{-6}} = 8.8419 \cdot 10^7 \frac{\text{N}}{\text{m}^2}$$

$$\sigma = \frac{F}{A} = \frac{60 \cdot 10^3}{677 \cdot 10^{-6}} = 8.9 \cdot 10^7$$

11.1

$$\varepsilon = \frac{\Delta l}{l} = \frac{0,09}{100} = 9 \cdot 10^{-4}$$

$$\sigma = \varepsilon \cdot E = 9 \cdot 10^{-4} \cdot 200 \cdot 10^9 = 1,8 \cdot 10^8 \frac{\text{N}}{\text{m}^2} \quad \frac{\sigma}{\varepsilon} = E$$

$$\sigma = \frac{F}{A} \Rightarrow F = \sigma \cdot A \cdot 1,8 \cdot 10^8 \quad 0,8 = \underline{\underline{144 \cdot 10^9 \text{ N}}}$$

11/2. 
$$\sigma = E \cdot \frac{\Delta l}{l}$$

$$\varepsilon = \frac{\Delta l}{l} = \frac{0,364}{500} = 7,28 \cdot 10^{-4}$$

$$\sigma = E \cdot \varepsilon = 7,28 \cdot 10^{-4} \cdot 210 \cdot 10^9 = 1,5288 \cdot 10^8 \frac{\text{N}}{\text{m}^2}$$

$$\sigma = \frac{l \cdot F}{A \cdot E} \Rightarrow A = \frac{l \cdot F}{\sigma \cdot E} \quad A = (D^2 - d^2) \frac{\pi}{4}$$

$$(D^2 - d^2) \frac{\pi}{4} = \frac{l \cdot F}{\sigma \cdot E} \Rightarrow D = \sqrt{\frac{4 \cdot l \cdot F}{\pi \cdot \sigma \cdot E} + d^2}$$

$$D = \sqrt{\frac{4 \cdot 0,5 \cdot 60 \cdot 10^3}{\pi \cdot 0,204 \cdot 10^8 \cdot 210 \cdot 10^9} + 30^2 \cdot 10^{-6}} = 20 \text{ mm}$$



11/3

$$\frac{\Delta l}{A \Delta d}$$

4000 mm<sup>2</sup>

$$\lambda = \frac{l \cdot F}{E \cdot A}$$

$$\lambda = \frac{2 \cdot 30 \cdot 10^3}{210 \cdot 10^9 \cdot 7,0626 \cdot 10^{-4}}$$

$$A = \frac{(30 \cdot 10^{-2})^2 \cdot \pi}{4} = 7,0686 \cdot 10^{-4}$$

$$\lambda = 4,042 \cdot 10^{-4}$$

$$\Sigma_K = \Sigma \cdot m = \frac{\lambda}{l} \cdot m = \frac{4,042 \cdot 10^{-4}}{2} \cdot 3 = 6,063 \cdot 10^{-4}$$

$$\Sigma_K = \frac{\Delta d - d_0}{d_0} \Rightarrow |\Sigma_K| = (\Sigma_K \cdot d_0) + d_0 = (6,063 \cdot 10^{-4} \cdot 30 \cdot 10^{-3}) + 30$$

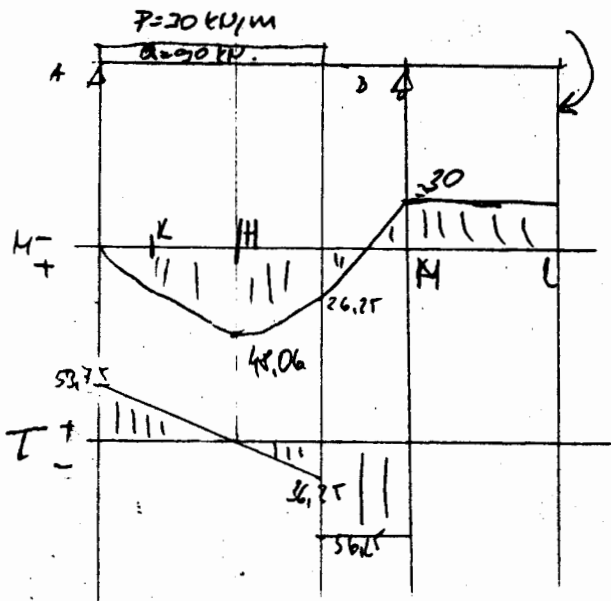
$$\underline{\underline{2,998 \cdot 10^1 \text{ mm}}}$$

$$\lambda = \frac{l \cdot F}{E \cdot A} = \frac{1,2 \cdot 150 \cdot 10^3}{70 \cdot 10^9 \cdot 4000 \cdot 10^{-6}} + \frac{0,8 \cdot 150 \cdot 10^3}{70 \cdot 10^9 \cdot 4 \cdot 10^{-3}} = 1$$

$$\boxed{1 \text{ mm}}$$

14.15

Biro János  
E.R. 112



$M = 20 \text{ kNm}$

$F_A = 53,75 \text{ kN}$

$F_B = 56,25 \text{ kN}$

$$\bar{y} = \frac{M}{Jz} \cdot y$$

$x_0 = 1,73 \text{ cm}$

$$\bar{z} = \frac{V \cdot M_s}{Jz \cdot 2z}$$

$$M_s = \frac{3 \cdot 7 \cdot 1,5 + 3 \cdot 14 \cdot 8,5 + (3 \cdot 16 \cdot 18,5) - (2 \cdot 3 \cdot 18,5)}{2 \cdot 7 + 3 \cdot 14 + 3 \cdot 16 - 2 \cdot 2 \cdot 3}$$

$= 11,77 \text{ cm}$

$$J_z = \frac{3 \cdot 7^3}{12} + 3 \cdot 7 \cdot 10,27^2 + \frac{3 \cdot 14^3}{12} + 3 \cdot 14 \cdot 1,77^2 +$$

$$\left( \frac{16 \cdot 3^3}{12} - 2 \left( \frac{2 \cdot 3^3}{12} \right) \right) + (16 \cdot 3 - 12) \cdot 6,73^2 =$$

$= 4705,807 \text{ cm}^4$

$$M_s = (3 \cdot 16 - 12) \cdot 6,73 + (5 \cdot 23 \cdot 3 \cdot 2,615) = 283,3 \text{ cm}^3$$

$$\sigma_M = \frac{48,06 \cdot 10^3}{4705 \cdot 10^{-8}} \cdot 0,0223$$

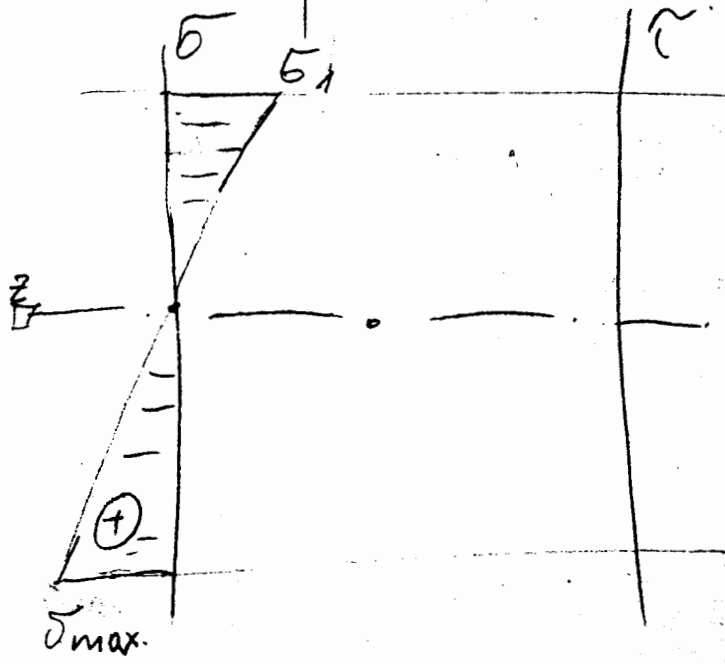
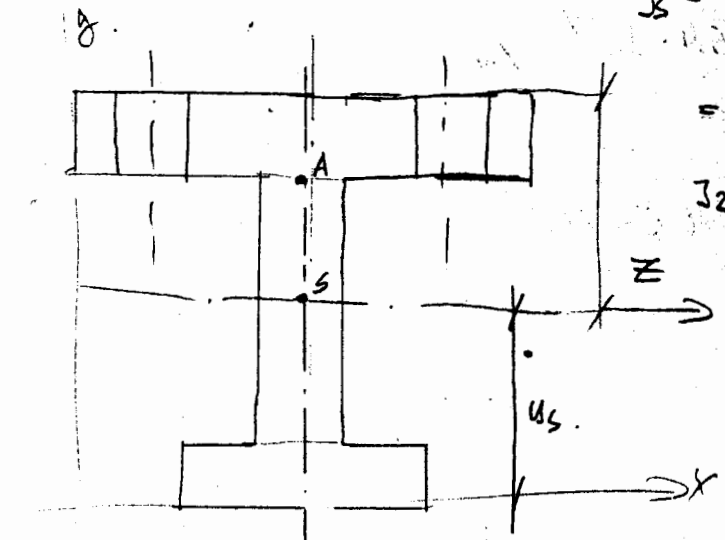
$= 8,4067 \cdot 10^3 \text{ Pa}$

$$\text{Hővezetési tényező} \sigma_{max} = \frac{48,06 \cdot 10^3}{4705 \cdot 10^{-8}} \cdot 0,11177$$

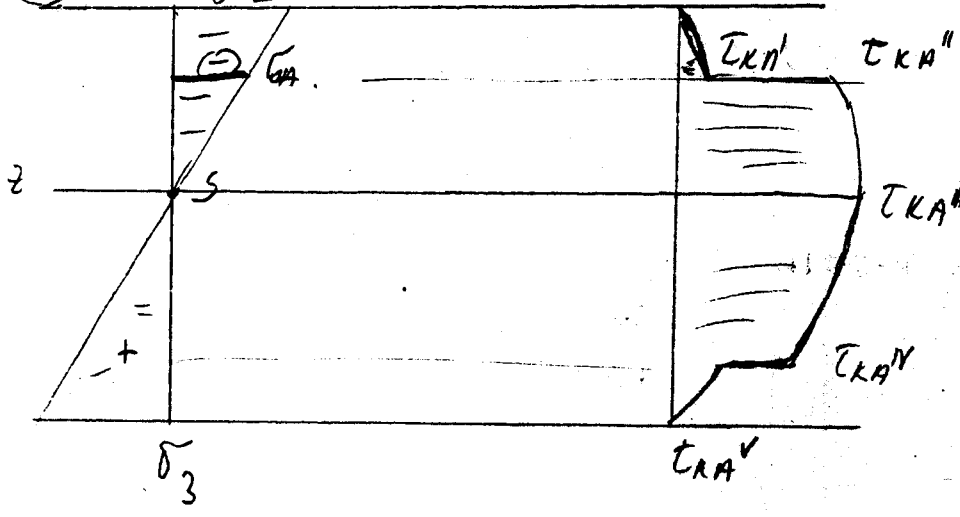
$$\sigma_{cs} = 1,2023 \cdot 10^8 \text{ Pa}$$

$$(M \rightarrow l) \text{ ben } \tau_{max} = \frac{56,75 \cdot 10^{-3} \cdot 283,3 \cdot 10^{-6}}{4705,8 \cdot 10^{-8} \cdot 0,03}$$

$= 1,1209 \cdot 10^7 \text{ Pa}$



1) - bou.  $\sigma_2$



$$1. 53,75 - 0,15 \cdot 30 =$$

$$= M_k = \underline{38,75 \text{ KNm}}$$

$$F_k = 53,75 - 30 = 23,75 \text{ kN}$$

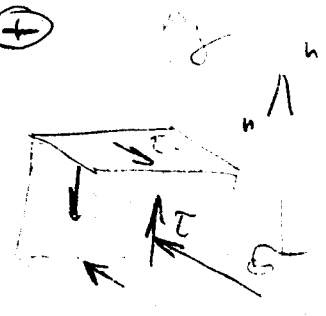
$$M_{sk} = (16 \cdot 3 - 12) \cdot 6,73 =$$

$$= 242,78 \text{ cm}^3$$

$$\sigma_3 = \frac{38,75 \cdot 10^3}{4705 \cdot 10^{-8}} \cdot 0,1177 = 9,69 \cdot 10^7 \text{ Pa} = \underline{\sigma_{k \max} \oplus}$$

$$\sigma_2 = \frac{38,75 \cdot 10^3}{4705 \cdot 10^{-8}} \cdot 0,0823 = 6,7782 \cdot 10^7 \text{ Pa} \ominus$$

$$\sigma_{KA} = \frac{38,75 \cdot 10^3}{4705 \cdot 10^{-8}} \cdot 0,0673 = \underline{\ominus 5,54 \cdot 10^7 \text{ N/m}^2}$$



$$\tau_{KA'} = \frac{23,75 \cdot 10^3 \cdot 242,78 \cdot 10^6}{4705 \cdot 10^8 \cdot 0,16} = 7,6443 \cdot 10^5$$

$$\tau_{KA''} = \frac{23,75 \cdot 10^3 \cdot 242,78 \cdot 10^6}{4705 \cdot 10^8 \cdot 0,03} = 4,0756 \cdot 10^6$$

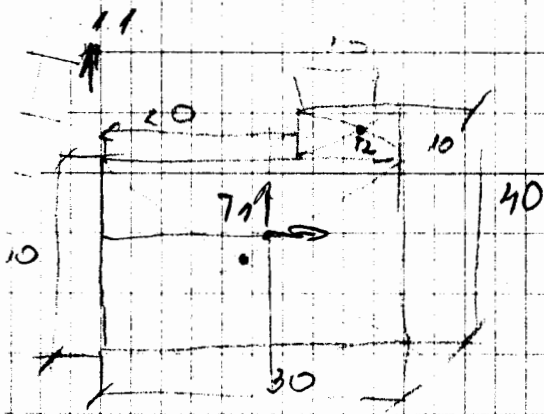
$$M_{sk2} = (36 \cdot 6,73) \cdot (5,73 \cdot 3 \cdot 2,615) = 283,3 \text{ cm}^3$$

$$\tau_{KAH} = \frac{23,75 \cdot 10^3 \cdot 283,3 \cdot 10^6}{4705 \cdot 10^8 \cdot 0,03} = 4,776 \cdot 10^6$$

$$M = 3 \cdot 7 \cdot 10,277 = 215,67 \text{ cm}^3$$

$$\tau_{KAH'} = \frac{23,75 \cdot 10^3 \cdot 215,67 \cdot 10^6}{4705 \cdot 10^8 \cdot 0,03} = 3,628 \cdot 10^6$$

$$\tau_{KAH''} = \frac{23,75 \cdot 10^3 \cdot 215,67 \cdot 10^6}{4705 \cdot 10^8 \cdot 0,07} = 1,55 \cdot 10^6$$



$$T_1 = 9 \cdot 10^2$$

$$T_2 = 10^2$$

$$x_1 = 15$$

$$y_1 = 15$$

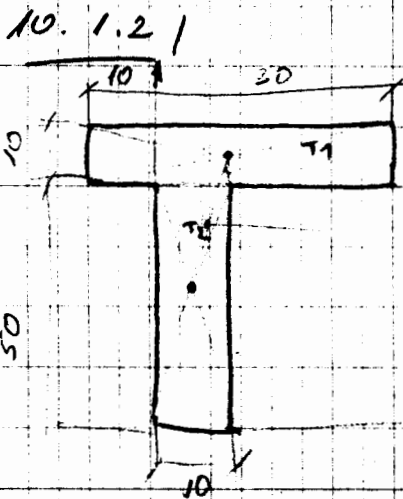
$$x_2 = 25$$

$$y_2 = 35$$

⇒ \*

$$\frac{9 \cdot 10^2 \cdot 15 + 10^2 \cdot 25}{9 \cdot 10^2 + 10^2} = x_3 = 16$$

$$\frac{9 \cdot 10^2 \cdot 15 + 10^2 \cdot 35}{9 \cdot 10^2 + 10^2} = y_2 = 17$$



$$T_1 = 4 \cdot 10^2$$

$$T_2 = 5 \cdot 10^2$$

$$x_1 = 10$$

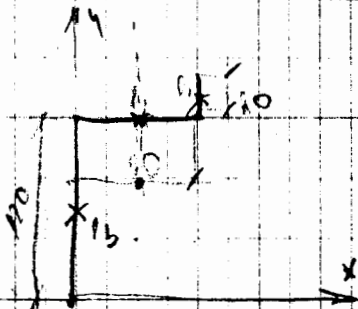
$$y_1 = 55$$

$$x_2 = 5$$

$$y_2 = 25$$

$$\frac{4 \cdot 10^2 \cdot 10 + 5 \cdot 10^2 \cdot 5}{4 \cdot 10^2 + 5 \cdot 10^2} = x_3 = 3,75$$

$$\frac{4 \cdot 10^2 \cdot 55 + 5 \cdot 10^2 \cdot 25}{4 \cdot 10^2 + 5 \cdot 10^2} = y_3 = 38,33$$



$$\frac{20 \cdot 50 + 50 \cdot 25 + 120 \cdot 0}{20 + 50 + 120} = 11,84$$

$$\frac{20 \cdot 130 + 50 \cdot 120 + 120 \cdot 60}{20 + 50 + 120} = 83,15$$



$$T_1 = \frac{50^2 \cdot \pi}{L}$$

$$T_2 = \frac{34^2 \cdot \pi}{L}$$

$$T_3 = 16 \cdot z$$

$$\frac{4}{3} \frac{R}{\pi} = \frac{4}{3} \cdot \frac{50}{\pi} \approx 21.2$$

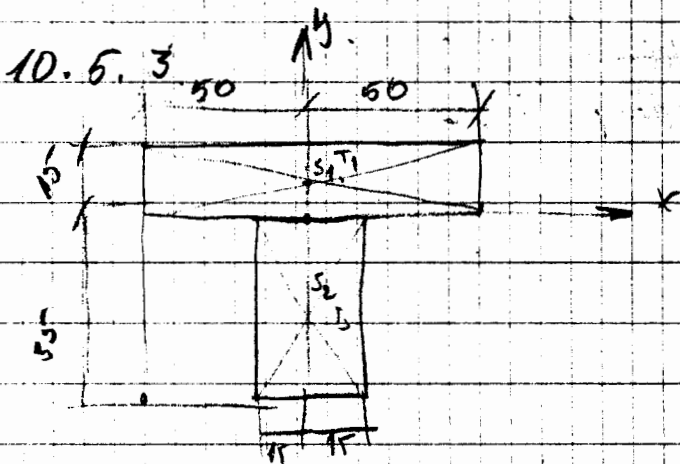
$$\frac{4}{3} \cdot \frac{34}{\pi} = 14.43$$

$$\frac{T_1 \cdot 21.2 \cdot L - T_2 \cdot 14.43 - T_3 \cdot \frac{z}{2}}{T_1 - T_2 + T_3} = 0$$

$$\frac{21.2 \cdot 3,927 \cdot 10^3 - 1,815 \cdot 10^3 \cdot 14.43 - 8 \cdot z^2}{3,927 \cdot 10^3 - 1,815 \cdot 10^3 + 8 \cdot z} = 0$$

$$8 \cdot z^2 = 57,061 \cdot 10^3$$

$$z = \frac{71 \cdot 10^3}{8} = 84,45$$



$$y_1 = 7.5$$

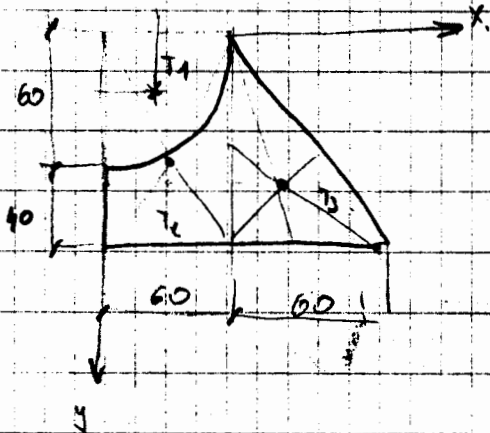
$$y_2 = 17.5$$

$$T_1 = 15 \cdot 10^3$$

$$T_2 = 1.05 \cdot 10^3$$

$$\frac{T_1 \cdot 7.5 - T_2 \cdot 17.5}{T_1 + T_2} = z = \frac{15 \cdot 10^3 \cdot 7.5 - 1.05 \cdot 10^3 \cdot 17.5}{15 \cdot 10^3 + 1.05 \cdot 10^3} = 2,794$$

10.4.3



$$T_1 = \frac{60^2 \cdot \pi}{4} = 9 \cdot \pi \cdot 10^2$$

$$\frac{4}{2} \cdot \frac{\pi}{8}$$

$$T_2 = 6 \cdot 10^3$$

$$\frac{4}{2} \cdot \frac{60}{31}$$

$$T_3 = 3 \cdot 10^3$$

$$x_1 = x_1 = 25.46$$

$$y_2 = 30 \quad y_2 = 50$$

$$x_3 = 80 \quad y_3 = 66.6$$

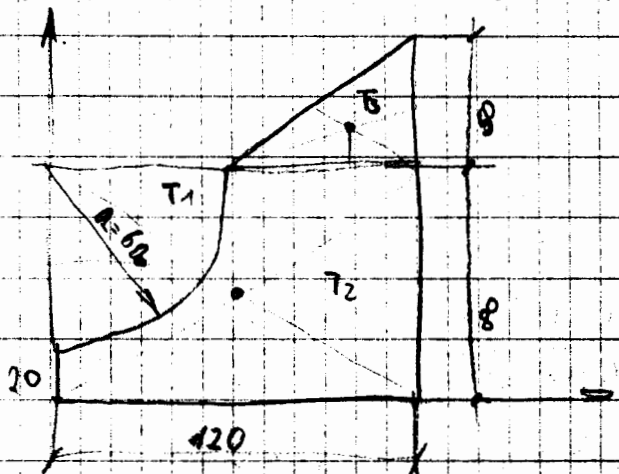
$$\frac{-T_1 \cdot 25.46 + T_2 \cdot 30 + T_3 \cdot 80}{-T_1 + T_2 + T_3} = y_2 = \frac{-28.27 \cdot 10^3 \cdot 25.46 + 6 \cdot 10^3 \cdot 30 + 3 \cdot 10^3 \cdot 80}{-2.827 \cdot 10^3 + 9 \cdot 10^3}$$

$$y_2 = 56.27$$

$$\frac{-T_1 \cdot 25.46 + T_2 \cdot 50 + T_3 \cdot 66.6}{-T_1 + T_2 + T_3} = y_3 = \frac{-2.827 \cdot 10^3 \cdot 25.46 + 6 \cdot 10^3 \cdot 50 + 3 \cdot 10^3 \cdot 66.6}{-2.827 \cdot 10^3 + 9 \cdot 10^3}$$

$$y_3 = 69.3077$$

10.4.6



$$T_1 = \frac{60^2 \cdot \pi}{4} = 2.827 \cdot 10^3$$

$$\frac{4}{2}$$

$$T_2 = 9.6 \cdot 10^3$$

$$T_3 = 1.5 \cdot 10^3$$

$$x_1 = \frac{4}{2} \cdot \frac{60}{\pi} = 2.54 \cdot 10 \quad y_1 = 54.53$$

$$y_2 = 60 \quad y_2 = 40$$

$$x_3 = 70 \quad y_3 = 96.6$$

$$\frac{-T_1 \cdot 2.54 \cdot 10 + T_2 \cdot 60 + T_3 \cdot 70}{-T_1 + T_2 + T_3} = y_2 = \frac{-2.827 \cdot 10^3 \cdot 2.54 \cdot 10 + 9.6 \cdot 10^3 \cdot 60 + 1.5 \cdot 10^3 \cdot 70}{-2.827 \cdot 10^3 + 9.6 \cdot 10^3 + 1.5 \cdot 10^3}$$

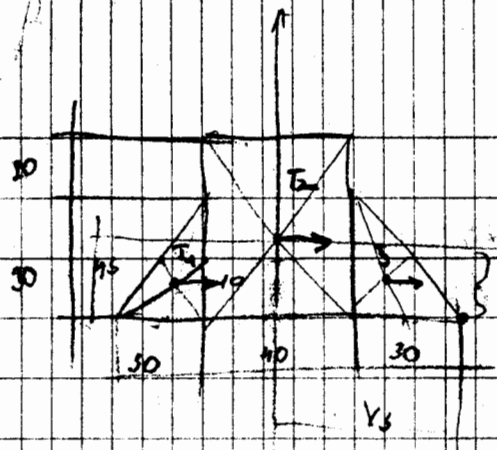
$$y_2 = 77.26$$

$$\frac{-T_1 \cdot 54.53 + T_2 \cdot 40 + T_3 \cdot 96.6}{-T_1 + T_2 + T_3} = y_3 = \frac{-2.827 \cdot 10^3 \cdot 54.53 + 9.6 \cdot 10^3 \cdot 40 + 1.5 \cdot 10^3 \cdot 96.6}{-2.827 \cdot 10^3 + 9.6 \cdot 10^3 + 1.5 \cdot 10^3}$$

$$y_3 = 45.27$$

$$T_2 = 2 \cdot 10^5$$

$$T_1 = T_3 = 4,5 \cdot 10^5$$

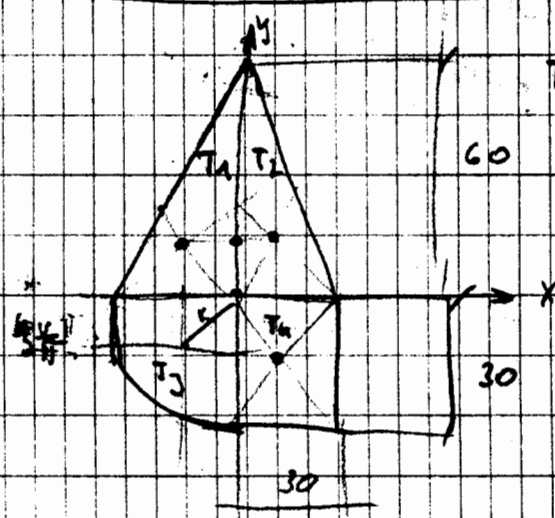


$$T_1 \cdot 10 + T_3 \cdot 10 + T_2 \cdot 2,5 \cdot 10 = Y_3 \cdot T_0$$

$$Y_3 = \frac{4,5 \cdot 10^5 \cdot 10 + 4,5 \cdot 10^5 \cdot 10 + 2 \cdot 10^5 \cdot 2,5 \cdot 10}{2 \cdot 10^5 + 4,5 \cdot 10^5} = \frac{59 \cdot 10^5}{6,5 \cdot 10^5} = 9,07$$

$$Y_3 = \frac{59}{6,5}$$

$$Y_3 = 9,07$$



$$T_2 = T_1 = 9 \cdot 10^5$$

$$T_3 = \frac{8 \cdot 10^5 \cdot 11}{4} = 7,06 \cdot 10^5$$

$$T_4 = 8 \cdot 10^5$$

$$x_1 = 2 \cdot 10 = x_2$$

$$y_1 = 2 \cdot 10 = y_2$$

$$x_3 = \frac{1}{3} \cdot \frac{30}{11} = y_3 \cdot 1,27 \cdot 10$$

$$y_4 = 15 = y_4$$

$$\left(\frac{11}{3} \frac{1}{11}\right)^2 + \left(\frac{11}{3} \frac{1}{11}\right)^2 = x$$

$$\sqrt{\frac{16}{9} \frac{1}{11} + \frac{16}{9} \frac{1}{11}} = x$$

$$\sqrt{2} \frac{4}{3} \frac{1}{11} = x$$

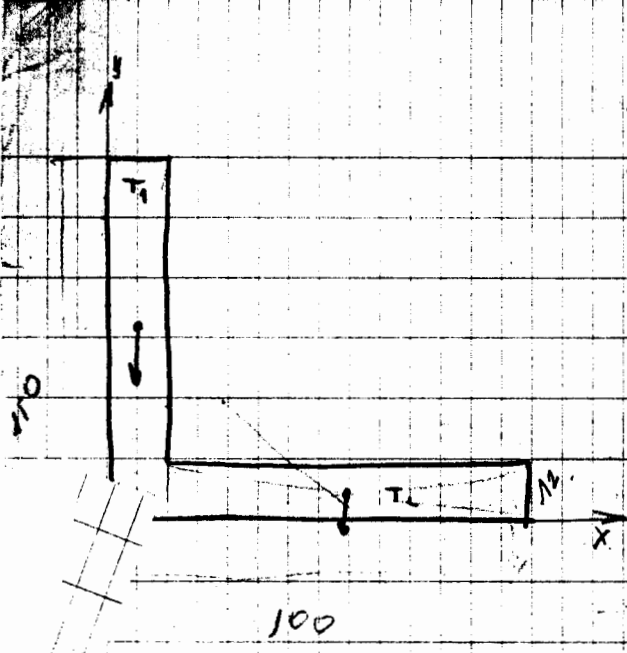
$$- T_1 \cdot 10 - T_3 \cdot 1,2 \cdot 10 + T_1 \cdot 10 + T_4 \cdot 1,5 \cdot 10 = Y_3 \cdot T_0$$

$$T_1 + T_2 + T_3 + T_4 = 0,235 \cdot 10^5$$

$$- 9 \cdot 10^5 - 7,06 \cdot 10^5 \cdot 1,2 + 9 \cdot 10^5 + 8 \cdot 1,5 \cdot 10 = Y_3 \cdot 10^5$$

$$9 \cdot 10^5 + 7,06 \cdot 10^5 + 9 \cdot 10^5 + 9 \cdot 10^5 = Y_3 \cdot 10^5$$





$$T_1 = 1,2 \cdot 10^3$$

$$T_2 = 1,056 \cdot 10^3$$

$$y_1 = 6$$

$$y_1 = 75$$

$$y_2 = 56$$

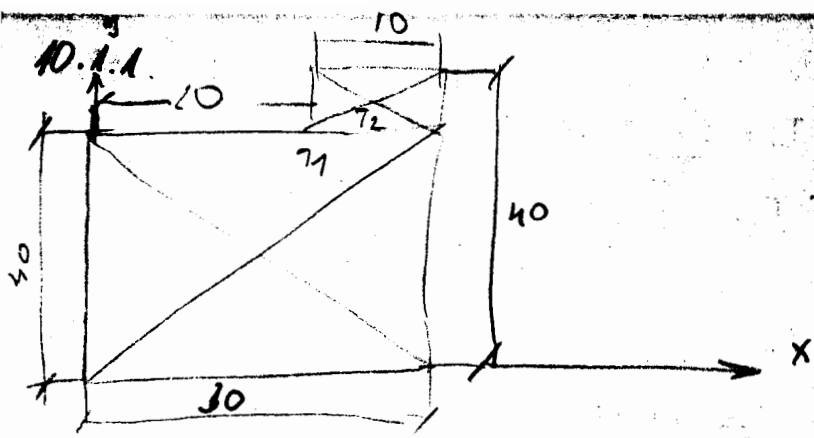
$$y_2 = 6$$

100

$$\frac{T_1 \cdot 6 + T_2 \cdot 56}{T_1 + T_2} = X_s = \frac{1,2 \cdot 10^3 \cdot 6 + 1,056 \cdot 10^3 \cdot 56}{1,2 \cdot 10^3 + 1,056 \cdot 10^3} = \underline{\underline{24,5}}$$

$$\frac{T_1 \cdot 75 + T_2 \cdot 6}{T_1 + T_2} = y_s = \frac{1,2 \cdot 10^3 \cdot 75 + 1,056 \cdot 10^3 \cdot 6}{1,2 \cdot 10^3 + 1,056 \cdot 10^3} = \underline{\underline{49,42}}$$

$\boxed{8,42 \text{ m}}$



$$T_1 = 9 \cdot 10^2$$

$$T_2 = 10^2$$

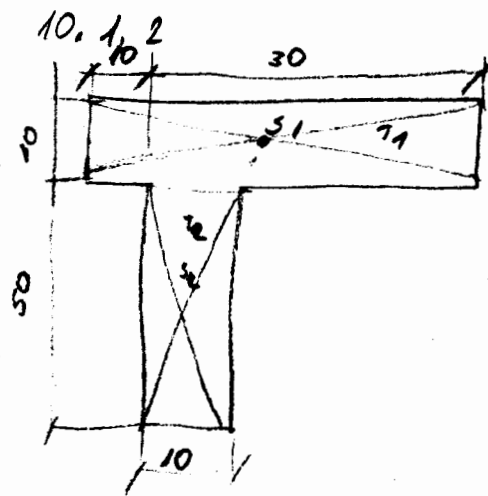
$$x_1 = 15 \quad y_1 = 15$$

$$x_2 = 25 \quad y_2 = 35$$

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$$\frac{9 \cdot 10^2 \cdot 15 + 10^2 \cdot 25}{9 \cdot 10^2 + 10^2} = x_s = 16$$

$$\frac{9 \cdot 10^2 \cdot 15 + 10^2 \cdot 35}{9 \cdot 10^2 + 10^2} = y_s = 17$$



$$T_1 = 4 \cdot 10^2$$

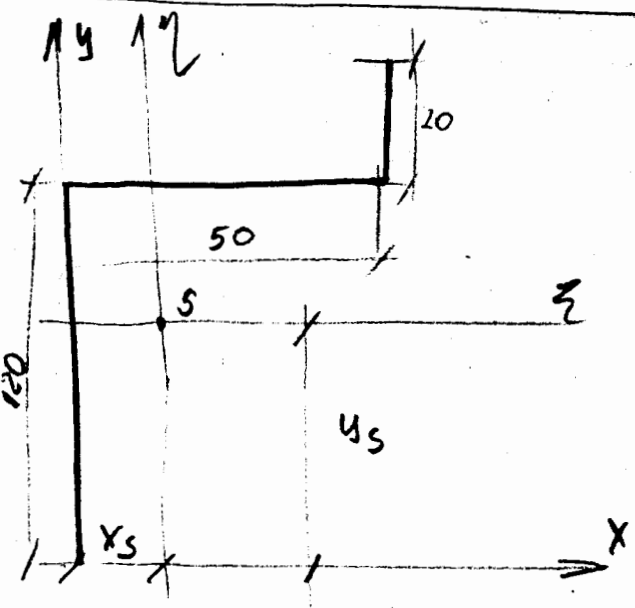
$$T_2 = 5 \cdot 10^2$$

$$x_1 = 10 \quad y_1 = 55$$

$$x_2 = 5 \quad y_2 = 25$$

$$\frac{4 \cdot 10^2 \cdot 10 + 5 \cdot 10^2 \cdot 5}{4 \cdot 10^2 + 5 \cdot 10^2} = x_s = 7.22$$

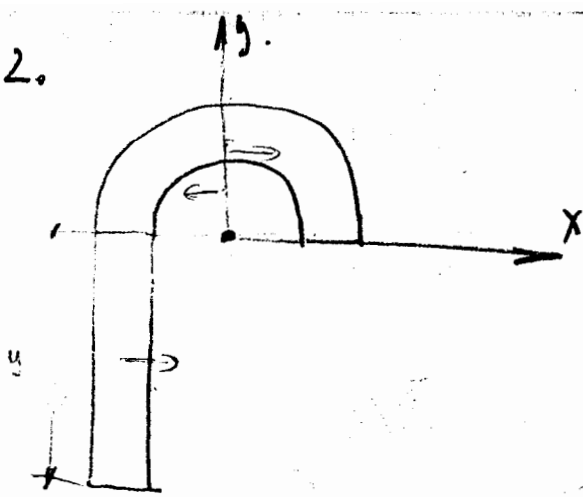
$$\frac{4 \cdot 10^2 \cdot 55 + 5 \cdot 10^2 \cdot 25}{4 \cdot 10^2 + 5 \cdot 10^2} = y_s = 38.73$$



$$\frac{20 \cdot 50 + 50 \cdot 20 + 120 \cdot 0}{20 + 50 + 120} = 11.84 = y_s$$

$$\frac{20 \cdot 130 + 50 \cdot 120 + 120 \cdot 60}{20 + 50 + 120} = 83.15 = x_s$$

10.2.



$$T_1 = \frac{50^2 \cdot \pi}{2}$$

$$T_2 = \frac{34^2 \cdot \pi}{2}$$

$$T_3 = 16 \cdot y$$

$$\frac{y}{3} \frac{\pi}{\pi} = \frac{y}{3} \cdot \frac{50}{\pi} = 21.2$$

$$\frac{y}{2} \cdot \frac{34}{\pi} = 14.43$$

$$y_1 = 21.2$$

$$y_2 = 14.43$$

$$y_3 = \frac{y}{2}$$

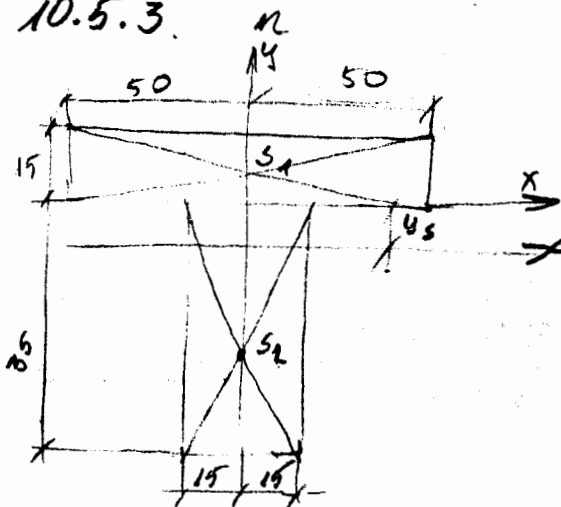
$$\frac{T_1 \cdot 21.2 - T_2 \cdot 14.43 - T_3 \cdot \frac{y}{2}}{T_1 - T_2 + T_3} = 0$$

$$\frac{21.2 \cdot 3,927 \cdot 10^3 - 1,815 \cdot 10^3 \cdot 14.43 - 8 \cdot y^2}{3,827 \cdot 10^3 - 1,815 \cdot 10^3 + 8 \cdot y} = 0$$

$$8y^2 = 57,062 \cdot 10^3$$

$$y = \underline{\underline{84,45}}$$

10.5.3.



$$y_1 = 7.5$$

$$T_1 = 15 \cdot 10^3$$

$$y_2 = 17.5$$

$$T_2 = 1.05 \cdot 10^3$$

$$y_3 = \frac{T_1 \cdot 7.5 - T_2 \cdot 17.5}{T_1 + T_2} = \frac{7.5 \cdot 15 \cdot 10^3 - 1.05 \cdot 17.5 \cdot 10^3}{15 \cdot 10^3 + 1.05 \cdot 10^3}$$

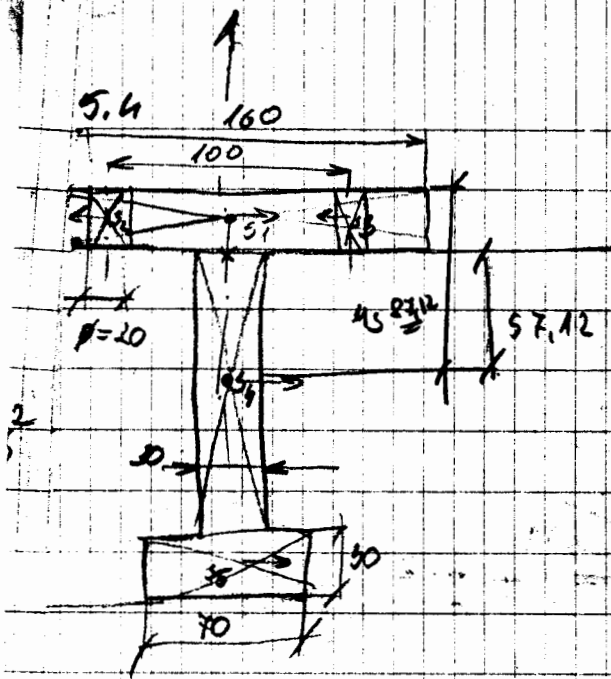
$$y_3 = \underline{\underline{2,794}}$$

$$T_1 = 4.8 \cdot 10^3$$

$$T_2 = T_3 = 0.6 \cdot 10^3$$

$$T_4 = 4.2 \cdot 10^3$$

$$T_5 = 2.1 \cdot 10^3$$



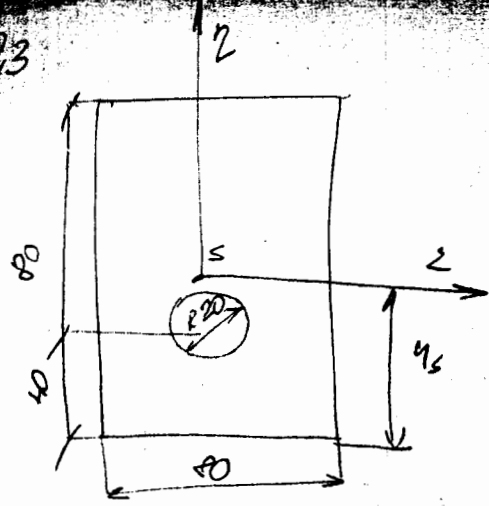
$x_1 = 0$	$y_1 = 15$
$x_2 = 50$	$y_2 = 15$
$x_3 = 100$	$y_3 = 15$
$x_4 = 160$	$y_4 = 170$
$x_5 = 160$	$y_5 = 156$

$$\frac{T_1 \cdot 15 - T_2 \cdot 15 - T_3 \cdot 15 - T_4 \cdot 70 - T_5 \cdot 170}{T_1 - T_2 - T_3 + T_4 + T_5} = 45$$

$$\frac{4.8 \cdot 10^3 \cdot 15 - 0.6 \cdot 10^3 \cdot 15 - 0.6 \cdot 10^3 \cdot 15 - 4.2 \cdot 10^3 \cdot 70 - 2.1 \cdot 10^3 \cdot 156}{4.8 \cdot 10^3 - 0.6 \cdot 10^3 - 0.6 \cdot 10^3 + 4.2 \cdot 10^3 + 2.1 \cdot 10^3} = -57.12$$

10.3

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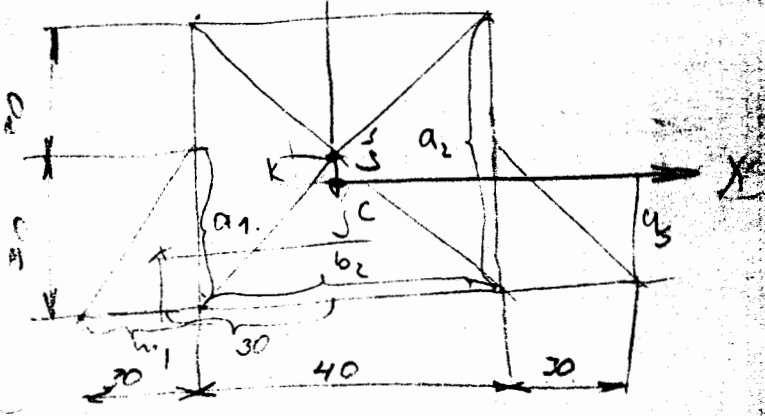


$$y_s = 6.32 \text{ cm}$$

$$J_z = \frac{8 \cdot 12^3}{12} + 8 \cdot 12 \cdot (0.32)^2 - \left[ \frac{4^4 \cdot \pi}{64} + 2^2 \cdot \pi \cdot (0.32)^2 \right] = 1081.62 \text{ cm}^4$$

$$J_y = \frac{12 \cdot 8^3}{12} - \left[ \frac{4^4 \cdot \pi}{64} \right] = 499.43 \text{ cm}^4$$

10.4.1

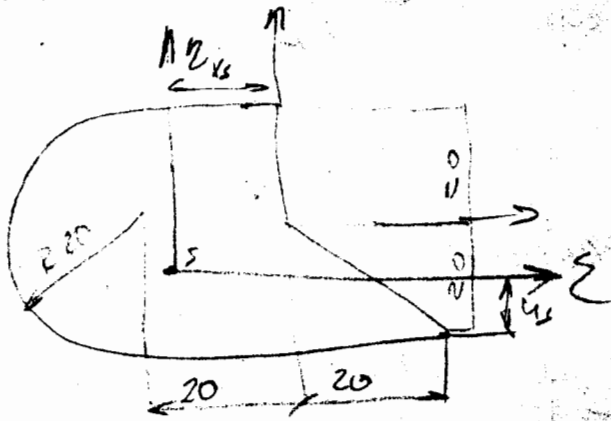


$$J_y = 2 \left[ \frac{a_1 \cdot w_1^3}{36} + \frac{a_1 \cdot w_1 \cdot 3^2}{2} \right] + \frac{a_2 \cdot b_2^3}{12} + a_2 \cdot b_2 \cdot 0^2 = 2 \left[ \frac{3 \cdot 3^3}{36} + \frac{3 \cdot 3 \cdot 3^2}{2} \right] + \frac{5 \cdot 4^3}{12} + 0 = 112.16 \text{ cm}^4$$

$$J_x = \left[ \frac{w_1 \cdot a_1^3}{36} + \frac{a_1 \cdot w_1 \cdot c^2}{2} \right] + \frac{a_2 \cdot b_2^3}{12} + a_2 \cdot b_2 \cdot k^2 =$$

$$= 2 \left[ \frac{3 \cdot 3^3}{36} + \frac{3 \cdot 3 \cdot 10^2}{2} \right] + \frac{5^3 \cdot 4}{12} + 5 \cdot 4 \cdot 0.47^2 = 60.118 \text{ cm}^4$$

10.4.2.



$$J_z = [$$

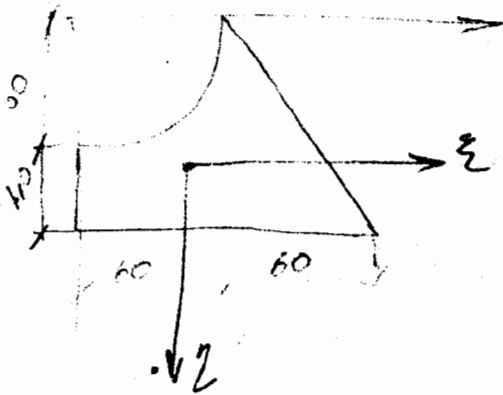
$$J_\eta = \left[ \frac{4^4 \cdot \pi}{64 \cdot 2} - \frac{2^2 \cdot \pi \left(\frac{4}{3} \frac{2}{\pi}\right)^2}{2} + \frac{2^2 \cdot \pi \left(\frac{4}{3} \frac{2}{\pi} + 0,52\right)^2}{2} \right] + \left[ \frac{4 \cdot 2^3}{12} + 4 \cdot 2 \cdot (0,418)^2 \right] +$$

$$+ \frac{2 \cdot 2^3}{36} + \frac{2 \cdot 2}{2} (2,146)^2 = 27,67$$

$$J_\xi = \left[ \frac{4^4 \cdot \pi}{64 \cdot 2} + \frac{2^2 \cdot \pi (2 - 1,837)^2}{2} \right] + \left[ \frac{2 \cdot 4^3}{12} + 2 \cdot 4 \cdot (2 - 1,837)^2 \right] +$$

$$+ \left[ \frac{2 \cdot 2^3}{36} + \frac{2 \cdot 2}{2} (1,168)^2 \right] = 20,169$$

10.4.3.



$$J_z = \left[ \frac{12^4 \cdot \pi}{256} - \frac{6^2 \cdot \pi \left(\frac{4}{3} \frac{6}{\pi}\right)^2}{4} + \frac{6^2 \cdot \pi \left(4,93 - \frac{4}{3} \frac{6}{\pi}\right)^2}{4} \right] + \frac{6 \cdot 10^3}{12} + 6 \cdot 10 (4,93 - 5)^2 + \frac{6 \cdot 10^3}{36} + \frac{10 \cdot 6}{2} (0,263)^2 =$$

$$= 277,83 \text{ cm}^4$$

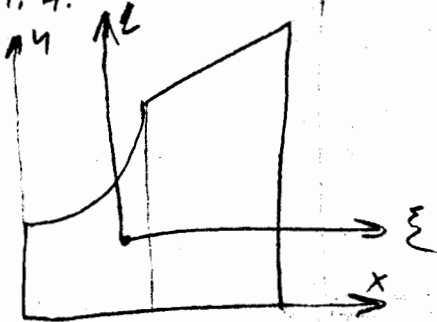
$$J_\eta = \left[ \frac{12^4 \cdot \pi}{256} - \frac{6^2 \cdot \pi \left(\frac{4}{3} \frac{6}{\pi}\right)^2}{4} + \frac{6^2 \cdot \pi \left(5,6 - \frac{4}{3} \frac{6}{\pi}\right)^2}{4} \right] + \frac{10 \cdot 6^3}{12} + 6 \cdot 10 (2,6)^2 + \frac{6 \cdot 10}{36} + \frac{10 \cdot 6}{2} (2,11)^2 =$$

$$= 483,6 \text{ cm}^4$$

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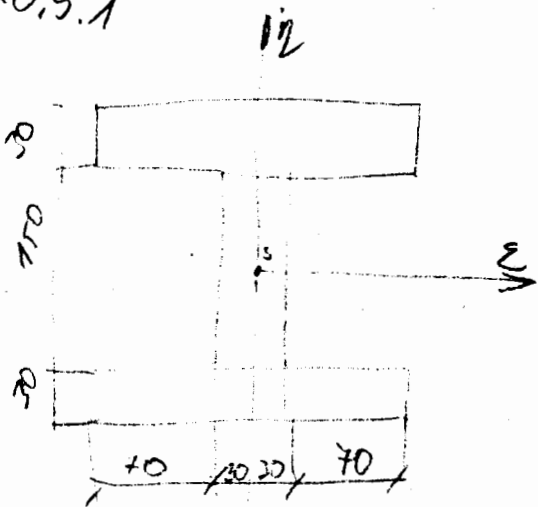
10.4.4.



$$J_x = - \left[ \frac{12^4 \cdot \pi}{256} - \frac{6^4 \cdot \pi}{4} \left( \frac{4}{3} \frac{6}{\pi} \right)^2 + \frac{6^4 \cdot \pi}{4} \left( 347 - \frac{4}{3} \frac{6}{\pi} \right)^2 \right] + \frac{12 \cdot 8^3}{12} + 12 \cdot 8 \cdot (0,47)^2 + \frac{6 \cdot 5^3}{36} + \frac{6 \cdot 5}{2} \left( \frac{5}{3} + 347 \right)^2 = 854,57$$

$$J_y = - \left[ \frac{12^4 \cdot \pi}{256} - \frac{6^4 \cdot \pi}{4} \left( \frac{4}{3} \frac{6}{\pi} \right)^2 + \frac{6^4 \cdot \pi}{4} \left( 7,9 - \frac{4}{3} \frac{6}{\pi} \right)^2 \right] + \frac{8 \cdot 12^3}{12} + 8 \cdot 12 \cdot (7,9 - 6)^2 + \frac{5 \cdot 6^3}{36} + \frac{5 \cdot 6}{2} (4,1 - 2)^2 = 1713,23$$

10.5.1



$$J_x = \left[ \frac{20 \cdot 3^3}{12} + 20 \cdot 3 \cdot 9^2 \right] \cdot 2 + \frac{6 \cdot 15^3}{12} = 11497,5 \text{ cm}^4$$

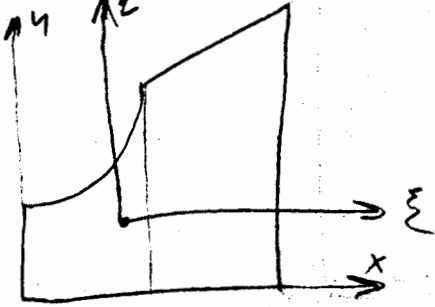
$$J_y = \left[ \frac{3 \cdot 20^3}{12} \right] \cdot 2 + \left[ \frac{15 \cdot 6^3}{12} \right] = 4240 \text{ cm}^4$$



Biro János

É.G. 112.

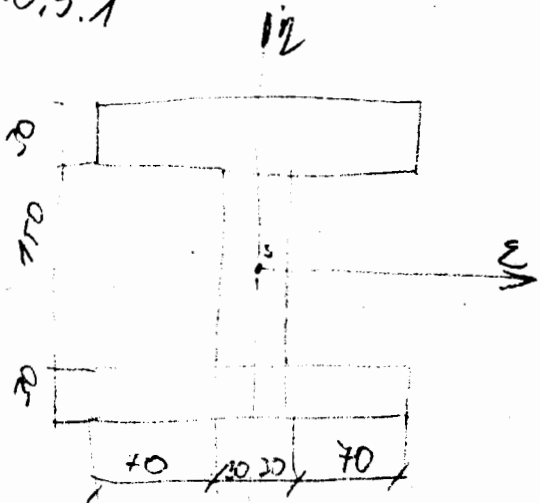
10.4.4.



$$J_z = - \left[ \frac{12^4 \cdot \pi}{256} - \frac{6^2 \cdot \pi}{4} \left( \frac{4}{3} \frac{6}{\pi} \right)^2 + \frac{6^4 \cdot \pi}{4} \left( 3,47 - \frac{4}{3} \frac{6}{\pi} \right)^2 \right] + \frac{12 \cdot 8^3}{12} + 12 \cdot 8 \cdot (0,417)^2 + \frac{6 \cdot 5^3}{36} + \frac{6 \cdot 5}{2} \left( \frac{5}{3} + 3,47 \right)^2 = 854,57$$

$$J_y = - \left[ \frac{12^4 \cdot \pi}{256} - \frac{6^2 \cdot \pi}{4} \left( \frac{4}{3} \frac{6}{\pi} \right)^2 + \frac{6^4 \cdot \pi}{4} \left( 7,9 - \frac{4}{3} \frac{6}{\pi} \right)^2 \right] + \frac{8 \cdot 12^3}{12} + 8 \cdot 12 \cdot (7,9 - 6)^2 + \frac{5 \cdot 6^3}{36} + \frac{5 \cdot 6}{2} (4,1 - 2)^2 = 1713,23$$

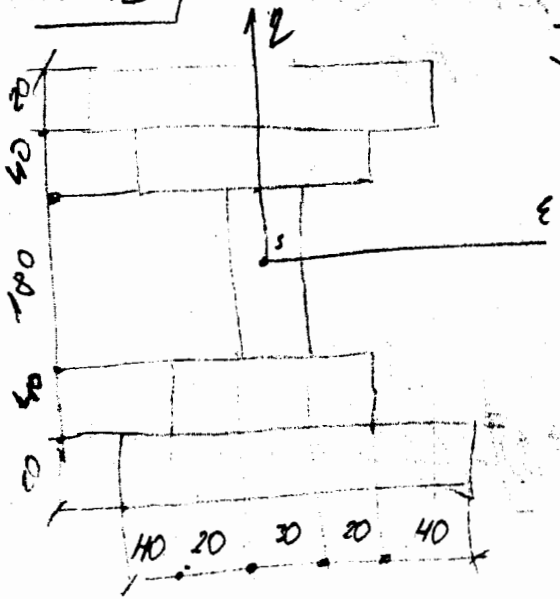
10.5.1



$$J_z = \left[ \frac{20 \cdot 15^3}{12} + 20 \cdot 3 \cdot 9^2 \right] \cdot 2 + \frac{6 \cdot 15^3}{12} = 11497,5 \text{ cm}^4$$

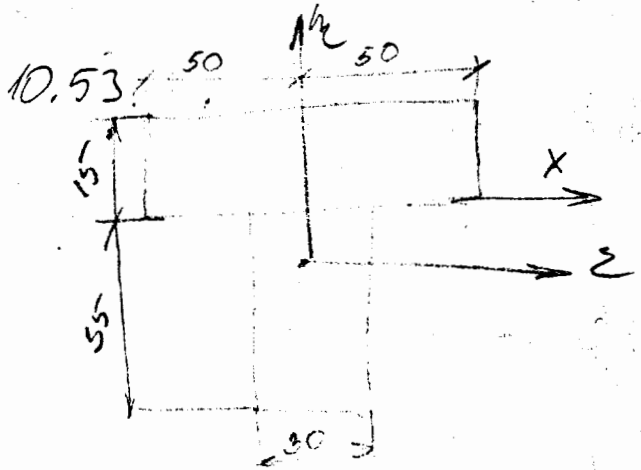
$$J_y = \left[ \frac{3 \cdot 20^3}{12} \right] \cdot 2 + \left[ \frac{15 \cdot 6^3}{12} \right] = 4240 \text{ cm}^4$$

10.5.2



$$J_z = 2 \left[ \frac{15 \cdot 2^3}{12} + 15 \cdot 2 \cdot 14^2 \right] + \left[ \frac{7 \cdot 4^3}{12} + 7 \cdot 4 \cdot 11^2 \right] \cdot 2 + \left[ \frac{3 \cdot 18^3}{12} \right] = 20088,667 \text{ cm}^4$$

$$J_y = 2 \left[ \frac{2 \cdot 15^3}{12} \right] + \left[ \frac{4 \cdot 7^3}{12} \right] \cdot 2 + \frac{18 \cdot 3^3}{12} = 1394,16 \text{ cm}^4$$

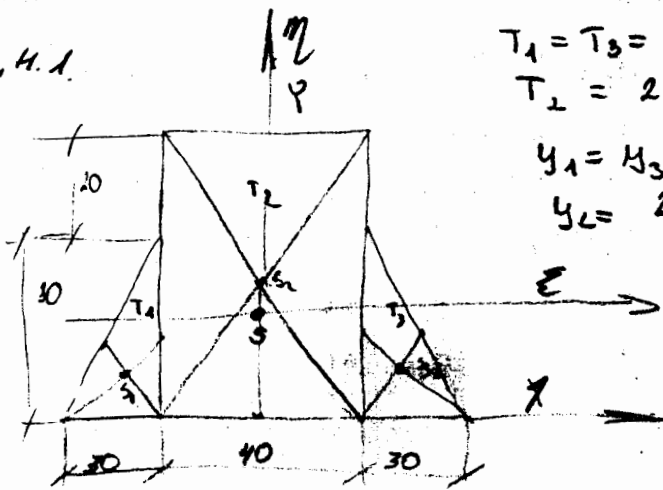


$$J_z = \frac{10 \cdot 15^3}{12} + 15 \cdot 10 \cdot (1.78)^2 + \frac{3 \cdot 36^3}{12} + 35 \cdot 3 \cdot (1.47)^2 = 83,74$$

$$J_y = \frac{15 \cdot 10^3}{12} + \frac{35 \cdot 3^3}{12} = 132,875 \text{ cm}^4$$

$$J_x = \frac{10 \cdot 15^3}{12} + 10 \cdot 15 \cdot (0.77)^2 + \frac{3 \cdot 35^3}{12} + 3 \cdot 35 \cdot (1.75)^2 = 54,125 \text{ cm}^4$$

10.4.1.



$$T_1 = T_3 = 4,5 \cdot 10^2$$

$$T_2 = 2 \cdot 10^3$$

$$y_1 = y_3 = 10$$

$$y_2 = 2,5 \cdot 10$$

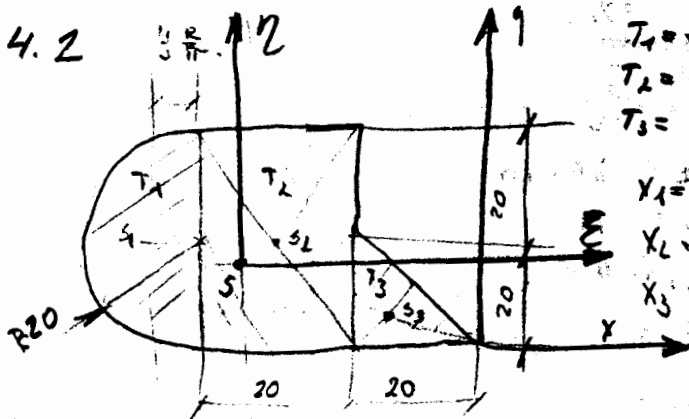
BIRÓ JÁNOS  
ÉFMR.

$$\frac{T_1 \cdot 10 + T_2 \cdot 2,5 \cdot 10 + T_3 \cdot 10}{T_e} = y_s = \frac{4,5 \cdot 10^2 \cdot 10 + 2 \cdot 10^3 \cdot 2,5 \cdot 10 + 4,5 \cdot 10^2 \cdot 10}{4,5 \cdot 10^2 + 4,5 \cdot 10^2 + 2 \cdot 10^3}$$

$$= \frac{0,45 \cdot 10^5 + 0,45 \cdot 10^5}{0,45 \cdot 10^5 + 0,45 \cdot 10^5 + 2 \cdot 10^3}$$

$y_s = 20,34$

10.4.2



$$T_1 = 0,628 \cdot 10^3$$

$$T_2 = 8 \cdot 10^2$$

$$T_3 = 2 \cdot 10^2$$

$$y_1 = 48,48$$

$$y_2 = 30$$

$$y_3 = 13,33$$

$\frac{y}{R}$

$$y_1 = 20$$

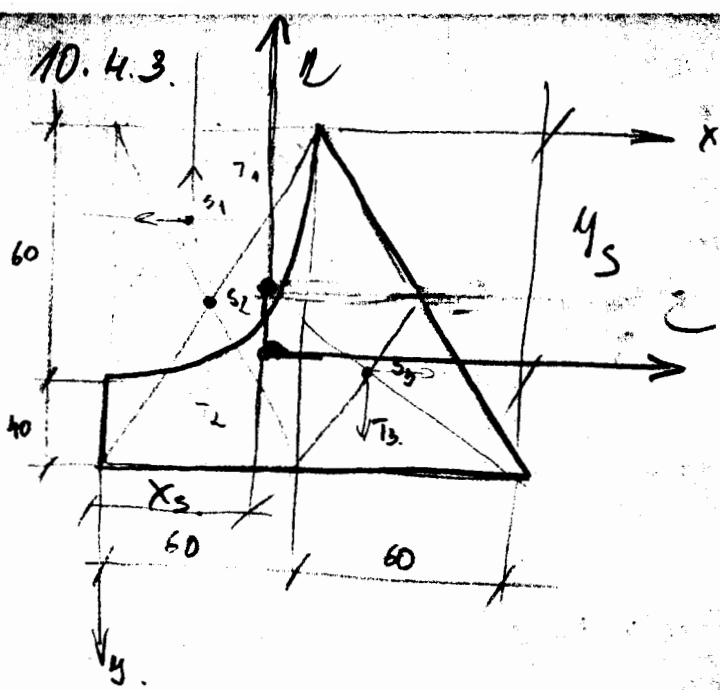
$$y_2 = 20$$

$$y_3 = 66$$

$$\frac{T_1 \cdot 48,48 + T_2 \cdot 30 + T_3 \cdot 13,33}{T_e} = x_s = \frac{0,628 \cdot 10^3 \cdot 48,48 + 8 \cdot 10^2 \cdot 30 + 2 \cdot 10^2 \cdot 13,33}{0,628 \cdot 10^3 + 0,8 \cdot 10^3 + 0,2 \cdot 10^3} = 39,08$$

$$\frac{T_1 \cdot 20 + T_2 \cdot 20 + T_3 \cdot 6,66}{T_e} = y_s = \frac{0,628 \cdot 10^3 \cdot 20 + 8 \cdot 10^2 \cdot 20 + 2 \cdot 10^2 \cdot 6,66}{0,628 \cdot 10^3 + 0,8 \cdot 10^3 + 0,2 \cdot 10^3} = 18,36$$

10.4.3.



$$T_1 = \frac{60^2 \cdot \pi}{4} = 9 \cdot \pi \cdot 10^2$$

$$T_2 = 6 \cdot 10^3$$

$$T_3 = 3 \cdot 10^3$$

$$x_1 = x_{s1} = 25.46$$

$$x_2 = 30 \quad y_2 = 50$$

$$x_3 = 80 \quad y_3 = 66.6$$

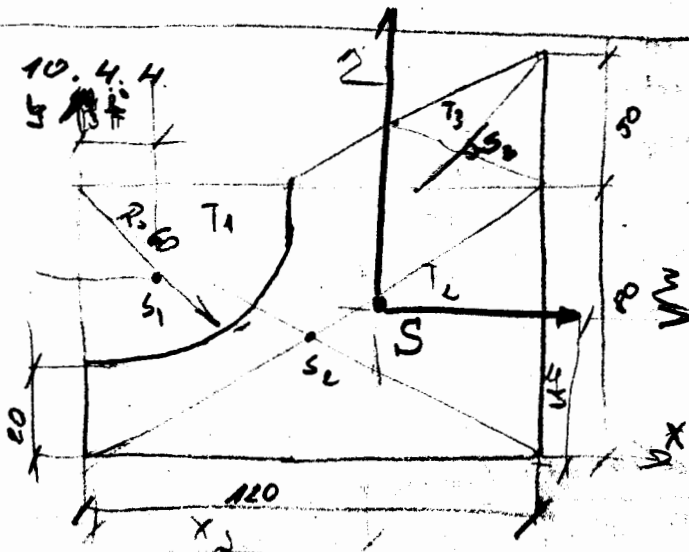
805  
15

$$-T_1 \cdot 25.46 + T_2 \cdot 30 + T_3 \cdot 80 = x_s = \frac{-2.827 \cdot 10^3 \cdot 25.46 + 6 \cdot 10^3 \cdot 30 + 3 \cdot 10^3 \cdot 80}{-2.827 \cdot 10^3 + 9 \cdot 10^3} = 56.37$$

$$-T_1 \cdot 25.46 + T_2 \cdot 50 + T_3 \cdot 66.6 = y_s = \frac{-2.827 \cdot 10^3 \cdot 25.46 + 6 \cdot 10^3 \cdot 50 + 3 \cdot 10^3 \cdot 66.6}{-2.827 \cdot 10^3 + 9 \cdot 10^3}$$

$$y_s = 69.305$$

10.4.4.



$$T_1 = \frac{60^2 \cdot \pi}{4} = 2.827 \cdot 10^3$$

$$T_2 = 9.6 \cdot 10^3$$

$$T_3 = 1.5 \cdot 10^3$$

$$x_1 = \frac{60}{3} = 2.54 \cdot 10$$

$$y_1 = 54.53$$

$$x_2 = 60$$

$$y_2 = 40$$

$$x_3 = 90$$

$$y_3 = 96.6$$

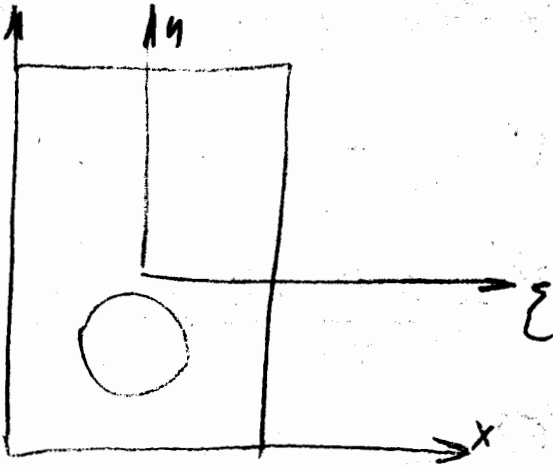
$$-T_1 \cdot 2.54 \cdot 10 + T_2 \cdot 60 + T_3 \cdot 90 = x_s = \frac{-2.827 \cdot 10^3 \cdot 2.54 \cdot 10 + 9.6 \cdot 10^3 \cdot 60 + 1.5 \cdot 10^3 \cdot 90}{-2.827 \cdot 10^3 + 9.6 \cdot 10^3 + 1.5 \cdot 10^3}$$

$$x_s = 79.05$$

$$-T_1 \cdot 54.53 + T_2 \cdot 40 + T_3 \cdot 96.6 = y_s = \frac{-2.827 \cdot 10^3 \cdot 54.53 + 9.6 \cdot 10^3 \cdot 40 + 1.5 \cdot 10^3 \cdot 96.6}{-2.827 \cdot 10^3 + 9.6 \cdot 10^3 + 1.5 \cdot 10^3}$$

$$y_s = 45.29$$

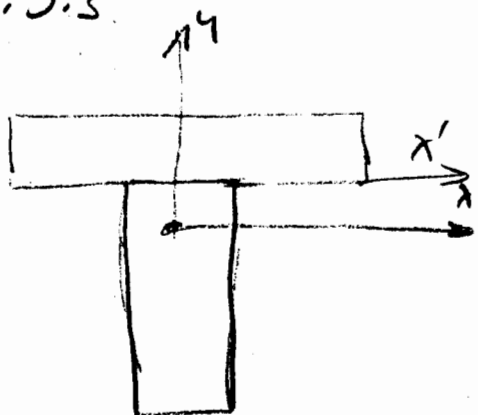
10.3.

 $I_x = 8$ 

$$J_z = \frac{8 \cdot 12^3}{12} + 2 \cdot 12 \cdot (0.32)^2 + \left[ \frac{4^4 \cdot \pi}{64} + 2^2 \cdot \pi \cdot (2.32)^2 \right] = 1081.6268$$

$$J_x = \frac{12 \cdot 8^3}{12} + \left[ \frac{4^4 \cdot \pi}{64} \right] = 499.43$$

10.5.3



$$J_x = \frac{10 \cdot 15^3}{12} + 15 \cdot 10 \cdot (1.78)^2 + \frac{3 \cdot 3.5^3}{12} + 3.5 \cdot 3 \cdot (1.47)^2 = 83.74$$

$$J_y = \frac{15 \cdot 10^3}{12} + \frac{3.5 \cdot 3^3}{12} = 132.875$$

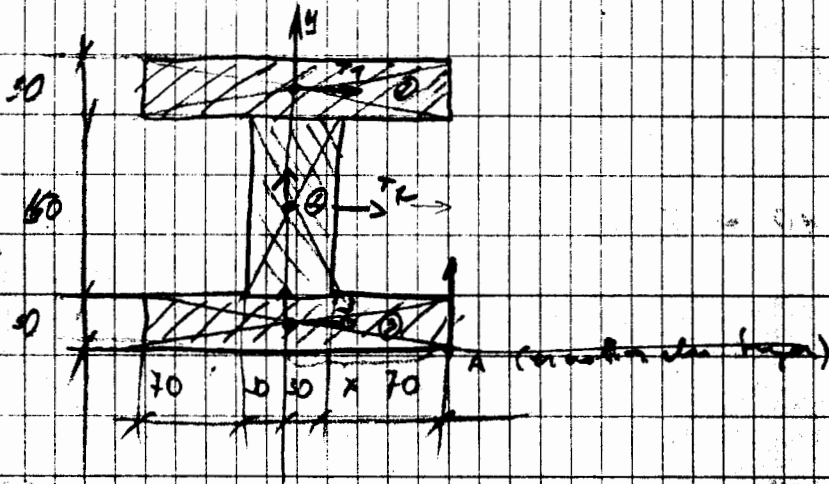
$$J_{x'} = \frac{10 \cdot 15^3}{12} + 10 \cdot 15 \cdot (0.25)^2 + \frac{3 \cdot 3.5^3}{12} + 3 \cdot 3.5 \cdot (1.25)^2 = 54.125$$

10.5.4.

# Seilárdsgáttan.

- Súlpoutba koncentration a fast greið  
 Akker eunnir a m's komeg rafhona kring  
 hit yonute'ðauð? aggreðs uð kull kinn  
 a. þin eð? yonute'ðauð? ómege'el.

43. 10. 5. 1. hlóðat.



- Þiggðlegur innvi á set  
 kottatol.
- Tarrilul no yos  
 aðlofós?
- a að? lúgu mindey  
 15 kenne mlot, de.  
 e fólaki olíun.  
 m'vori'fue jöl kunnþa  
 non.

$$T_1 = 6 \cdot 10^3$$

$$T_2 = 9 \cdot 10^3$$

$$T_3 = 6 \cdot 10^3$$

$$\sum M_A = 10^2 \cdot T_1 + 10^2 \cdot T_2 + 10^2 \cdot T_3 - T_c \cdot X$$

$$X = \frac{10^2 (T_1 + T_2 + T_3)}{T_c}$$

$$X = 10^4$$

$$T_c = (T_1 + T_2 + T_3)$$

- elfaul' fun 12 d'bró' f.

$$\sum M_B = T_1 \cdot 195 + T_2 \cdot 165 + T_3 \cdot 15 = T_c \cdot X_c$$

$$X_c = \frac{T_1 \cdot 195 + T_2 \cdot 165 + T_3 \cdot 15}{T_c + T_c + T_c}$$

$$X_c = \frac{114 \cdot 10^5 + 945 \cdot 10^5 + 97 \cdot 10^5}{21 \cdot 10^3}$$

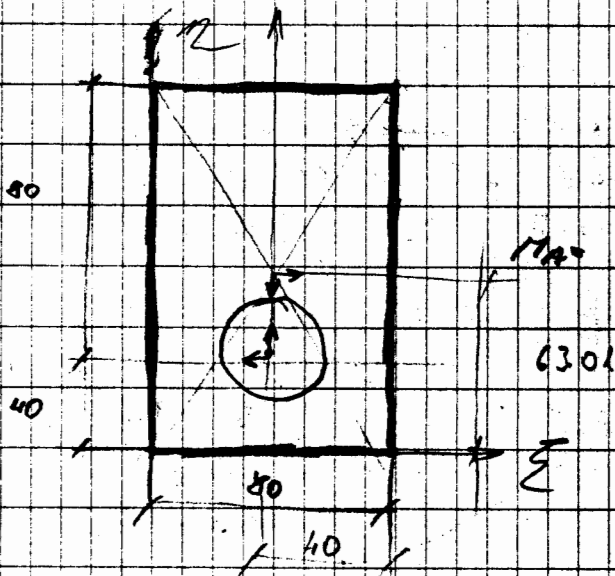
$$X_c = \frac{2176 \cdot 10^5}{21 \cdot 10^3} = 105 \cdot 10^2$$

Þetta hlóð 2  
 elte 2  
 viðmið X1 2



10. 3 flucht 1:

- alle Kräfte auf  $CoB$  ein



$$T_1 = 9.5 \cdot 10^3$$

$$T_2 = 7 \cdot 10^3 \cdot 1.8 = 12.56 \cdot 10^3$$

$$\sum M_A = T_1 \cdot 10 \cdot 4 - T_2 \cdot 4 \cdot 40 = T_B \cdot X$$

$$X = \frac{(T_1 - T_2) \cdot 40}{T_C}$$

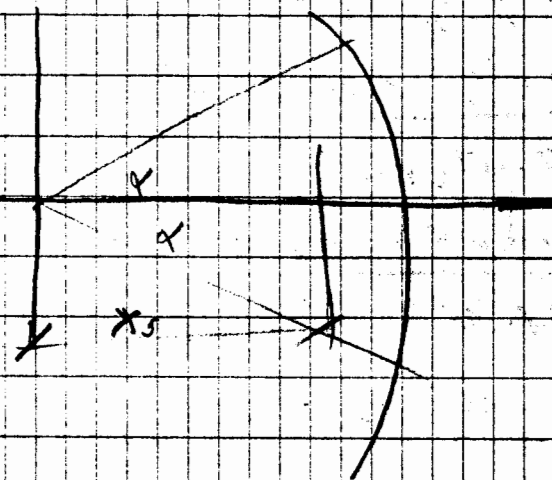
$$X = 4 \cdot 10$$

$$\sum M_B = T_1 \cdot 6 \cdot 10 - T_2 \cdot 4 \cdot 10 = T_D \cdot Y$$

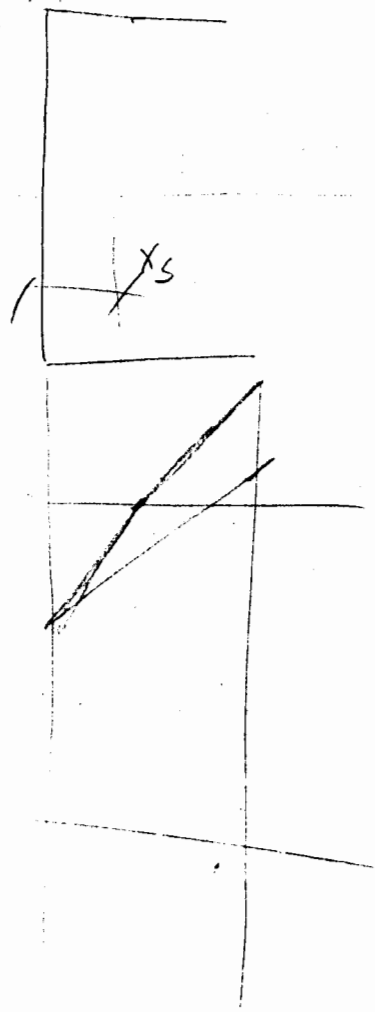
$$Y = \frac{9.5 \cdot 10^3 \cdot 6 \cdot 10 - 4 \cdot 10 \cdot 1.256 \cdot 10^3}{9.6 \cdot 10^3 - 1.256 \cdot 10^3}$$

$$Y = 0.301$$

Kurve: internel und externer Kräfte



14.2.1



$$x_s = \frac{(1.6 \cdot 3) \cdot 2 + (0.7 \cdot 14 \cdot 0.35)}{(2 \cdot 1.6) + (0.7 \cdot 14)} = 1.8087 \text{ cm}$$

$$J_0 = L \left( \frac{1.6^3}{12} + 1.6 \cdot (1.192)^2 \right) + \left( \frac{14 \cdot 0.7^3}{12} + 0.7 \cdot 14 \cdot (1.48^2) \right) = 174.78 \text{ cm}^4$$

$$M_{s\bar{0}} (15 \cdot 1 \cdot 3.442 \cdot 2) = 10.326 \cdot \text{cm}^3$$

$$\bar{\sigma} = \frac{25 \cdot 10^3}{71.25 \cdot 10^{-8}} \cdot 0.0269 = 9.4386 \cdot 10^8 \text{ Pa}$$

$$T = \frac{5 \cdot 10^3 \cdot 10.326}{71.28 \cdot 10^8 \cdot 0.02} = 34.75 \cdot 10^6$$



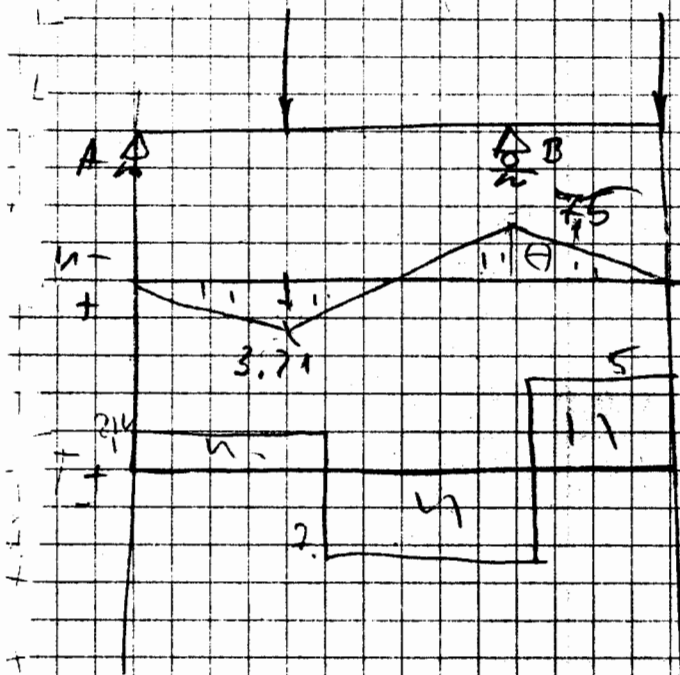
$$J_2 = \frac{14 \cdot 6^3}{12} + 14 \cdot 6 \cdot (1.192)^2 - \left( \frac{42 \cdot 5.3^3}{12} + 12 \cdot 5.3 \cdot (1.542)^2 \right) = 71.249 \text{ cm}^4$$

$$\bar{\sigma} = \frac{25 \cdot 10^3}{71.75 \cdot 10^{-8}} \cdot 0.01808 = 634 \cdot 10^8$$

$$\bar{\sigma}_{\text{max}} = \frac{25 \cdot 10^3}{71.25} \cdot 0.0419 = 1.41709 \cdot 10^{11}$$

$$10^4 \text{ cm}^4$$

$$\frac{120 \cdot 10^5}{10^4} \cdot 15$$



$\sum M_A = 0$

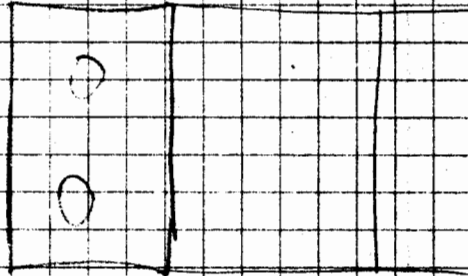
$$1.5 \cdot 10 + 6 \cdot 5 = 3.71 \cdot 10$$

$$F_D = 12.85$$

$$\sum \gamma = 0 \quad 2.14 = F_A$$

$$\sigma = \frac{M}{I_z} \cdot y =$$

$$\sigma = \frac{7.5 \cdot 10^5}{2000} \cdot 5 =$$



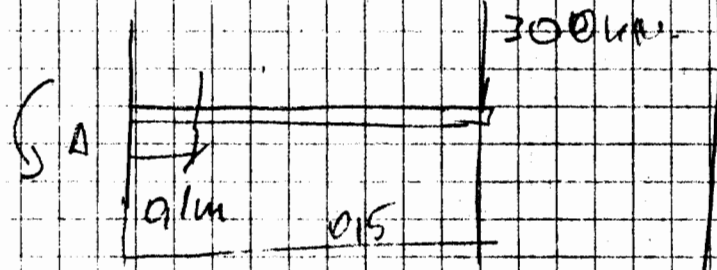
$$J_z = \frac{4 \cdot 10^3}{12} \left[ \frac{2^4 \cdot \pi}{64} + \frac{2^2 \cdot \pi}{4} \cdot 9 \right]$$

$$J_z = 275$$

$$\sigma_{\text{max}} = 5.45 \uparrow \frac{\text{N}}{\text{cm}^2}$$

$$\sigma_{\text{min}} = \frac{2.5 \cdot 10^5}{313} \cdot 2$$

14/13



$$J_z = \frac{12,5 \cdot 30^2}{12} + 2 \cdot \frac{5 \cdot 1,5 \cdot 30^2}{12}$$

$$\underline{10000 \text{ cm}^4}$$

$\Sigma M_A = 150 \text{ kNm}$   
 $\Rightarrow \underline{120 \text{ kNm}}$

$$\sigma = \frac{M}{J_z} \cdot y = \frac{120 \cdot 10^5}{10^4} \cdot 15 = 18000 \frac{\text{N}}{\text{cm}^2}$$

$$\tau = \frac{J_z \cdot M_z}{J_z \cdot z} = \frac{300 \cdot 10^5 \cdot 394,976}{10^4 \cdot 1,2}$$

$$\tau = \underline{9874,4} \frac{\text{N}}{\text{cm}^2}$$

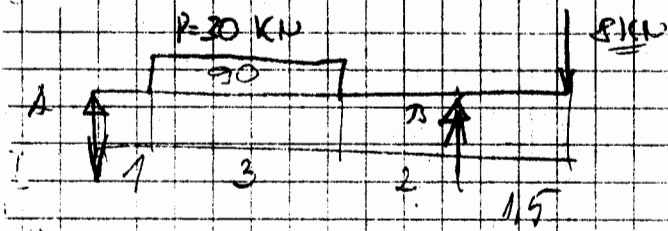
$$M_z = 12,5 \cdot 1,6 \cdot 14,2 + 1,2 \cdot 13,6 \cdot 6,8$$

$$M_z = \underline{394,976 \text{ cm}}$$

14.12

JAMES LOST

E WENET WJÄR

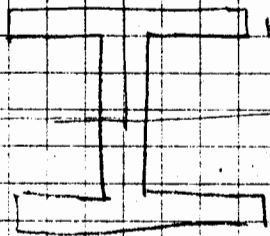


$$\sum M_A = 0 \Rightarrow 2,5 \cdot 90 + 4,5 \cdot P - 6 \cdot F_B = 0$$

$$F_B = 47,5 \text{ kN}$$

$$\sum X_i = 0 \Rightarrow 30 + P - 47,5 + F_A = 0$$

$$F_A = 9,5 \text{ kN}$$



$$\sigma = \frac{M}{I_z} \cdot y$$

$$\frac{12 \cdot 10^5}{5287,3}$$

$$\sigma = \frac{12 \cdot 10^5}{5287,3} \cdot 11 = \dots$$

$$M_{K1} = 12 \text{ kNm}$$

$$24,57 \text{ MPa}$$

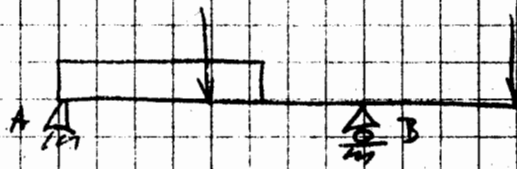
$$I_{zK1} = \frac{16 \cdot 280^3}{12} + 2 \left[ \frac{7 \cdot 11 \cdot 196^3}{12} \right] = 5287,3 \text{ cm}^4$$

$$\tau = \frac{T}{I_z} \frac{M_s}{2z} =$$

$$\begin{aligned} \tau &= \frac{8 \cdot 10^3 \cdot 309 \cdot 156}{5287,3 \cdot 1,8} = \\ &= 2,59 \cdot 10^2 \frac{\text{N}}{\text{cm}^2} = \\ &= 2,59 \cdot 10^6 \frac{\text{N}}{\text{m}^2} = \\ &= 2,59 \text{ MPa} \end{aligned}$$

$$\begin{aligned} M_s &= 16 \cdot 1,2 \cdot 11,6 + \\ &+ 11,8 \cdot 9,3 \cdot 4,9 \\ M_s &= 309,156 \text{ cm}^3 \end{aligned}$$

14/1/1



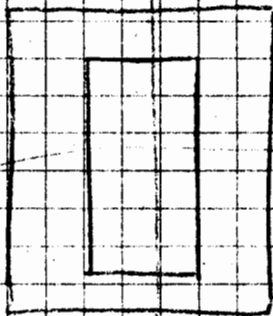
$$\sum M_A = 0 \Rightarrow 15 \cdot 60 + 2 \cdot 20 + 6 \cdot 5 - F_B \cdot 4 = 0 \Rightarrow F_B = \underline{40 \text{ kN}}$$

$$\sum Y_i = 0 \Rightarrow F_A = 45 \text{ kN}$$

$$\sigma = \frac{M}{J_z} \cdot z$$

$$M_{ki} = 3 \cdot 45 - 15 \cdot 60 - 1 \cdot 20 = 25 \text{ kNm}$$

$$J_z = \frac{12 \cdot 14^3}{12} - \frac{5 \cdot 12^3}{12} = 2074 \text{ cm}^4$$



$$\sigma_{\text{max}} = \frac{25 \cdot 10^5}{2074} \cdot 14 = 1.729 \cdot 10^4 \frac{\text{N}}{\text{cm}^2}$$

$$1.729 \cdot 10^6 \frac{\text{N}}{\text{m}^2}$$

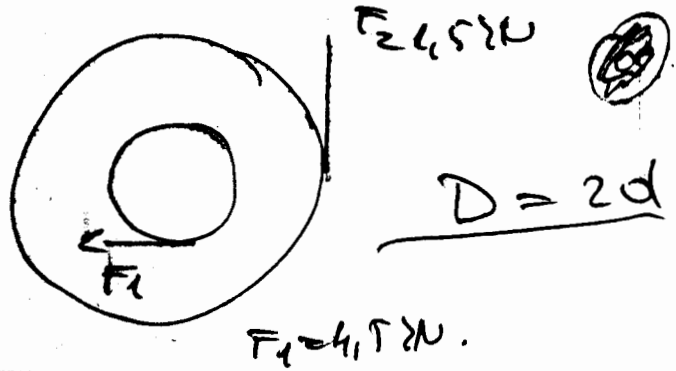
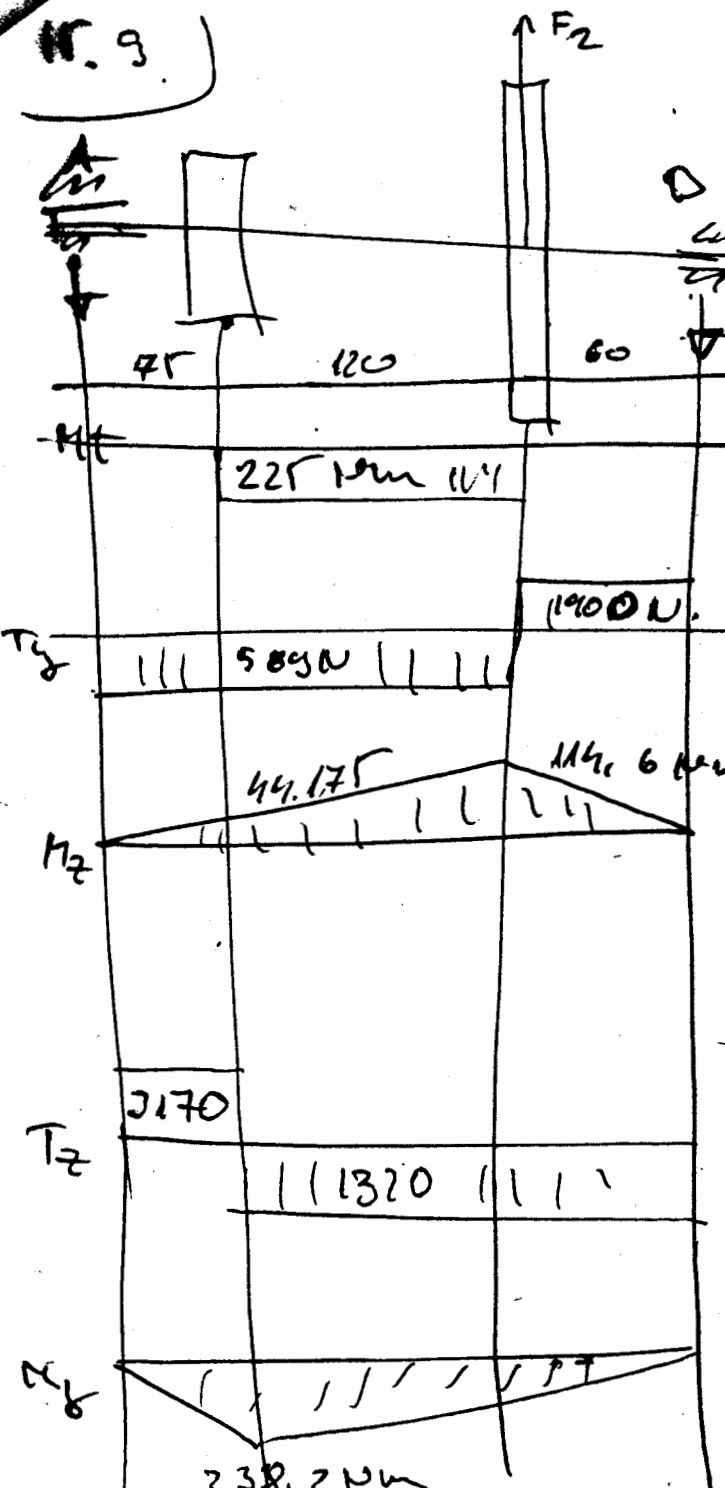
$$\tau_{xy \text{ max}} = \frac{M_s}{J_z} (z)$$

$$\tau_{\text{max}} = \frac{35 \cdot 10^3 \text{ N} \cdot 14 \text{ m}}{2074 \cdot 7} = 1.02 \cdot 10^7 \frac{\text{N}}{\text{m}^2}$$

$$M_s = (12 \cdot 7 \cdot 6) - (5 \cdot 6 \cdot 3)$$



11.9



$\sigma_{req} = 180 \text{ MPa}$   
 $\tau_{req} = 170 \text{ MPa}$

$$M_y = \sqrt{44.175^2 + 238.2^2} = 242.26$$

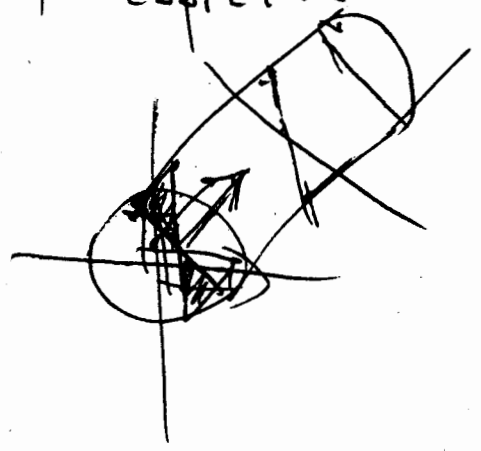
$$D = 2 \sqrt{\frac{2 \cdot 32.16}{\pi \cdot 15}} =$$

$$D = \sqrt[3]{\frac{16 \cdot 32 \cdot 17}{\pi \cdot 15 \cdot 8}} = \underline{\underline{27.1 \text{ cm}}}$$

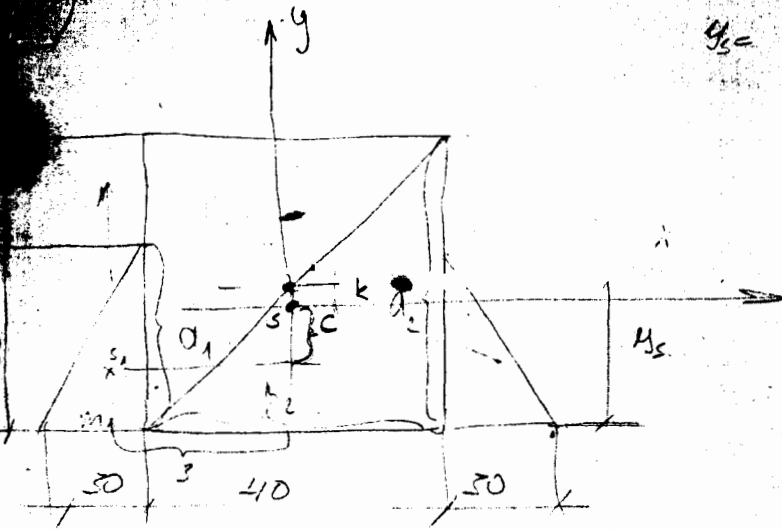
$M_{red} = 330.62 \text{ Nm}$

$J_x = 2.4913 \cdot 10^{-8} \text{ m}^4$

$$\sigma_{req} = \frac{M_{red} \cdot r}{J} = 179.8 \text{ MPa}$$



$$y_s = 2.03 \text{ cm}$$



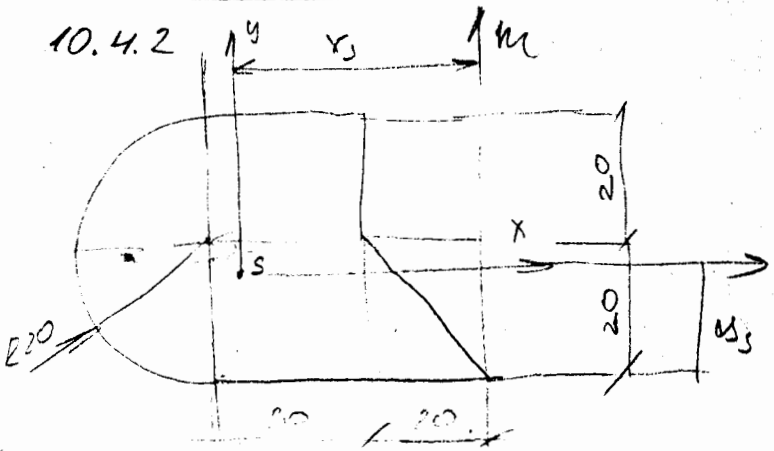
$$J_y = 2 \left[ \frac{a_1 \cdot m_1^3}{36} + \frac{a_1 \cdot m_1 \cdot 3^2}{2} \right] + \frac{a_2 \cdot b_1^3}{12} + \frac{a_2 \cdot b_2 \cdot 0^2}{12} =$$

$$= 2 \left[ \frac{3 \cdot 3^3}{36} + \frac{3 \cdot 3 \cdot 3^2}{2} \right] + \frac{5 \cdot 4^3}{12} + 0 = \underline{\underline{112.16 \text{ cm}^4}}$$

$$J_x = 2 \left[ \frac{m_1 \cdot a_1^3}{36} + \frac{a_1 \cdot m_1 \cdot c^2}{2} \right] + \frac{a_1^2 \cdot b_2}{12} + a_2 \cdot b_2 \cdot k^2$$

$$J_x = 2 \left[ \frac{3 \cdot 3^3}{36} + \frac{3 \cdot 3 \cdot 1.03^2}{2} \right] + \frac{5 \cdot 3 \cdot 4}{12} + 5 \cdot 4 \cdot 0.147^2 = 60.128$$

10.4.2



$$x_s = 3.48$$

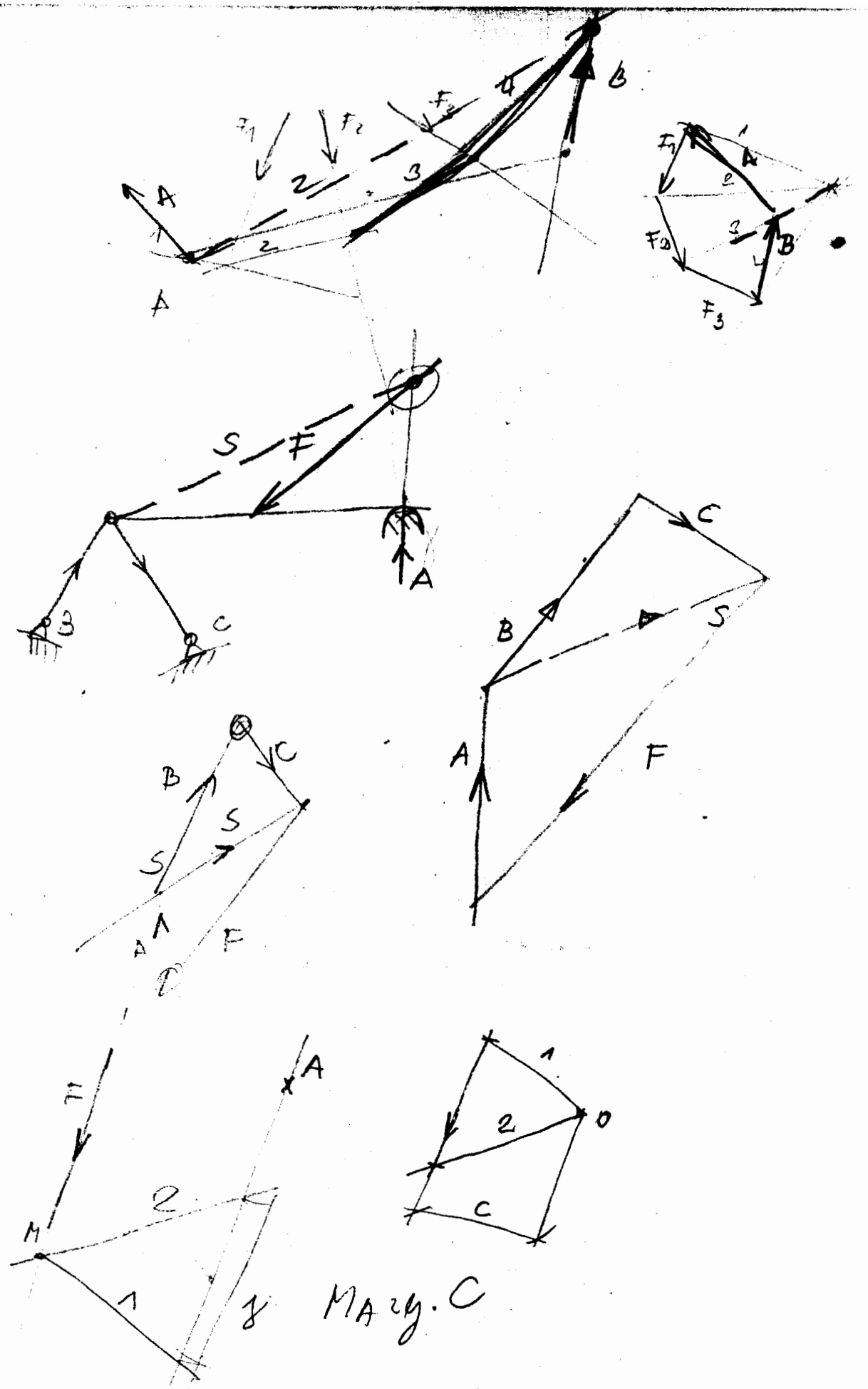
$$y_s = 1.835$$

$$J_y = \left[ \frac{44\pi}{64 \cdot 2} - \frac{2^2 \cdot \pi \cdot \left(\frac{4}{3} \cdot \frac{2}{\pi}\right)^2}{2} + \frac{2^2 \cdot \pi \cdot \left(\frac{4}{3} \cdot \frac{2}{\pi} + 0.52\right)^2}{2} \right] + \left[ \frac{4 \cdot 2^3}{12} + 4 \cdot 2 \cdot (0.48)^2 \right] +$$

$$+ \frac{2 \cdot 2^3}{36} + \frac{2 \cdot 2}{2} \cdot (2.146)^2 = 27.69$$

$$J_x = \left[ \frac{4 \cdot \pi}{64 \cdot 2} + \frac{2^2 \cdot \pi \cdot (2 - 1.835)^2}{2} \right] + \left[ \frac{2 \cdot 4^2}{12} + 2 \cdot 4 \cdot (2 - 1.835)^2 \right] +$$

$$+ \left[ \frac{2 \cdot 2^3}{36} + \frac{2 \cdot 2}{2} \cdot (1.168)^2 \right] = 20.169$$



MARY. C